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**SOUTHEAST ROCKFORD
GROUNDWATER CONTAMINATION
PHASE II RI
WORK PLAN AND SAMPLING PLAN
FOR SOIL GAS SURVEY**

Prepared For:

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1.0 INTRODUCTION

This work plan and sampling plan has been prepared to document the screening activities conducted for Source Area 7 and to define the scope of soil gas sampling activities to be performed as part of the Phase II Remedial Investigation/Feasibility Study (RI/FS) at the Southeast Rockford Groundwater Contamination site in Rockford, Illinois. The Phase II remedial investigation will involve a source investigation, groundwater investigation, residential well sampling and residential air sampling. The soil gas sampling, which will be performed during the fall of 1992, and the Source Area 7 screening activities conducted in May and June of 1992, constitute a portion of the Phase II source investigation, but will be performed before the remainder of Phase II RI work. Accordingly, this work plan and sampling plan is presented separately from the work plan documents for the remainder of Phase II RI work. The Source Area 7 study and Phase II soil gas sampling work will be conducted according to the procedures set forth in the Phase I Quality Assurance Project Plan and Health and Safety Plan (CDM 1991).

The following paragraphs describe the tasks to be performed under this work plan. Section 7 provides the schedule for these activities and Section 8 contains the detailed cost estimate for each task.

Task 1 - Work Plan and Sampling Plan Preparation

This plan has been designed to provide a brief site background for the study area (Section 2) and to describe the scope of the soil gas (Section 4) and Source Area 7 tasks (Appendix A). Additionally, a detailed description of the sampling and analysis to be performed under this work plan is provided in Sections 3 through 6 and Appendices A and B. The proposed schedule and budget for all tasks are provided in Sections 7 and 8.

Included in the budget for this task are costs associated with quality assurance and project management for this portion of the Phase II activities. Quality assurance issues include document review and overall technical quality review. Project management tasks will include Agency coordination and reporting, staff supervision and coordination, subcontractor monitoring, and budget and schedule control. These costs are included in the Professional 4 and 5 labor categories.

Task 2 - Screening Level Activities for Potential Source Area 7

In May of 1992, CDM was tasked by IEPA to perform a screening level survey for buried wastes and organic vapors in soil gas in potential Source Area 7. The scope of this work is included as Appendix A. Section 8 provides the cost breakdown for the completed task. The scope of this task was previously approved by IEPA; however, a contract amendment has not been issued for this work. In an effort to simplify the contract amendment process, CDM requests that this task be included in the amendment for this work plan.

Task 3 - Upon approval of this plan, soil gas surveys will be conducted in 12 potential source areas. These areas were identified based on Phase I data, aerial photographs, site visits, and information regarding industrial activities. The rationale and procedures for the soil gas survey are described in detail in Sections 2 through 5 and Appendix B.

Task 4 - A brief technical memorandum will be prepared summarizing the results of the soil gas survey. The memorandum will be incorporated into the Phase II Remedial Investigation Report and will not be a separate deliverable. An in-house technical review will be conducted for this memorandum.

2.0 STUDY AREA DESCRIPTION AND INITIAL EVALUATION

The study area is located in Southeast Rockford in Winnebago County and covers approximately 10 square miles. The study area is bounded by Broadway to the north, Wendy Lane to the east, Sandy Hollow Road to the south, and the Rock River to the west. The area is shown in Figure 2-1. The northern boundary of the Phase I study area was Harrison Avenue. The study area has been expanded northward to Broadway because sampling results have indicated that source areas may exist outside the original site boundaries and it appears that the contamination plume also extends beyond the Phase I study area.

2.1 GEOLOGIC SETTING

The stratigraphy of the study area consists of bedrock with locally significant subsurface relief that is overlain by unconsolidated glacial sediments of variable thickness. The uppermost bedrock unit is generally dolomite, which forms a subsurface valley greater than 200 feet deep in the western part of the study area. Glacial sediments are thickest within this bedrock valley and thinnest on the valley flanks. The glacial sediments and the bedrock constitute two hydraulically-connected aquifers; no areally extensive aquitards were identified.

2.2 CONTAMINANT AND SOURCE ASSESSMENT

2.2.1 GROUNDWATER CONTAMINATION

Studies conducted by the IEPA, IDPH, USEPA, TAT and CDM indicate a number of contaminants detected in the groundwater in the study area. The historical ranges of detection for the major contaminants of concern at the site are listed in Table 2-1.

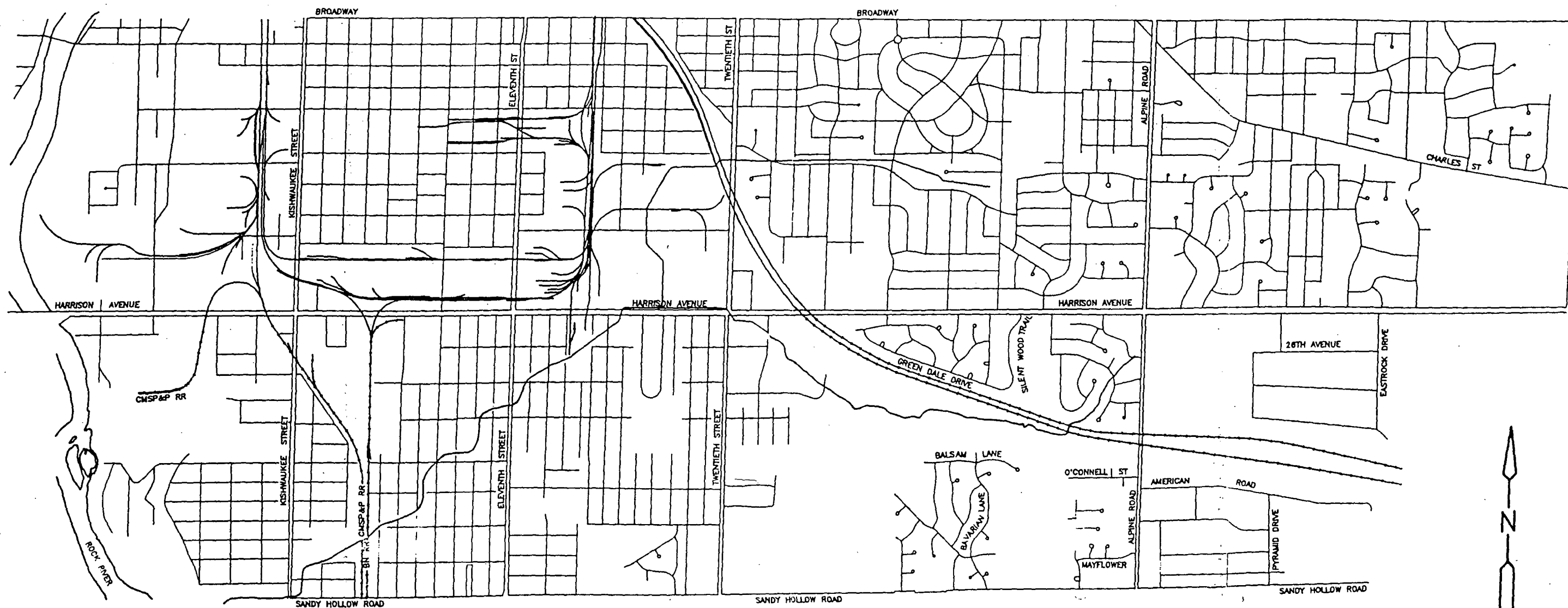
TABLE 2-1

**HISTORICAL CONCENTRATION RANGES OF CONTAMINANTS
DETECTED AT SOUTHEAST ROCKFORD STUDY AREA****MAJOR CONTAMINANTS****RANGE (ug/l)***

Trichloroethylene (TCE)	ND to 3,600
1,1,1-Trichloroethane (1,1,1-TCA)	ND to 12,000
cis-1,2-Dichloroethylene (cis-1,2-DCE)	ND to 4,100
trans-1,2-Dichloroethylene (trans-1,2-DCE)	ND to 55
1,1-Dichloroethylene (1,1-DCE)	ND to 940
Tetrachloroethylene (PCE)	ND to 1,200
1,2-Dichloroethane (1,2-DCA)	ND to 62
1,1-Dichloroethane (1,1-DCA)	ND to 2,900

ND = Not Detected.

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SOUTHEAST ROCKFORD

STUDY AREA

Chlorinated organic compounds have been the constituents detected the most frequently and at the highest concentrations in the study area. The compound 1,1,1-trichloroethane (TCA) has been detected at the highest concentrations, followed by trichloroethene (TCE), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), tetrachloroethene (PCE), and cis-1,2-dichloroethene (cis-1,2-DCE). Several of the compounds detected (cis-1,2-DCE, 1,1-DCA, 1,1-DCE, chloroethane, and vinyl chloride) are not used in large quantities for industrial or other purposes within the study area, but are common degradation products of TCA and TCE.

Phase I sampling results indicate two major areas of groundwater contamination of volatile organic compounds: 1) a large area near and downgradient (west-northwest) from well nest MW106; and 2) a smaller area centered on the industrial facility southeast of the intersection of Harrison Avenue and Alpine Road. Also, data from the Operable Unit sampling shows that smaller contaminant plumes exist west-southwest of MW20.

Though several localized detections were reported for Phase I samples, there is no evidence of significant migration of semi-volatiles, pesticides, or inorganic contaminants in the groundwater. Aluminum, iron, and manganese exceeded secondary MCLs in some groundwater samples; these occurrences probably reflect a combination of natural concentrations and localized contamination.

2.2.2 POTENTIAL GROUNDWATER CONTAMINANT SOURCE AREAS

Utilizing a groundwater modeling program, CDM was able to fingerprint groundwater contamination throughout the study area, map the migration of contaminant plumes from their potential source areas, and delineate water table contours within the study area.

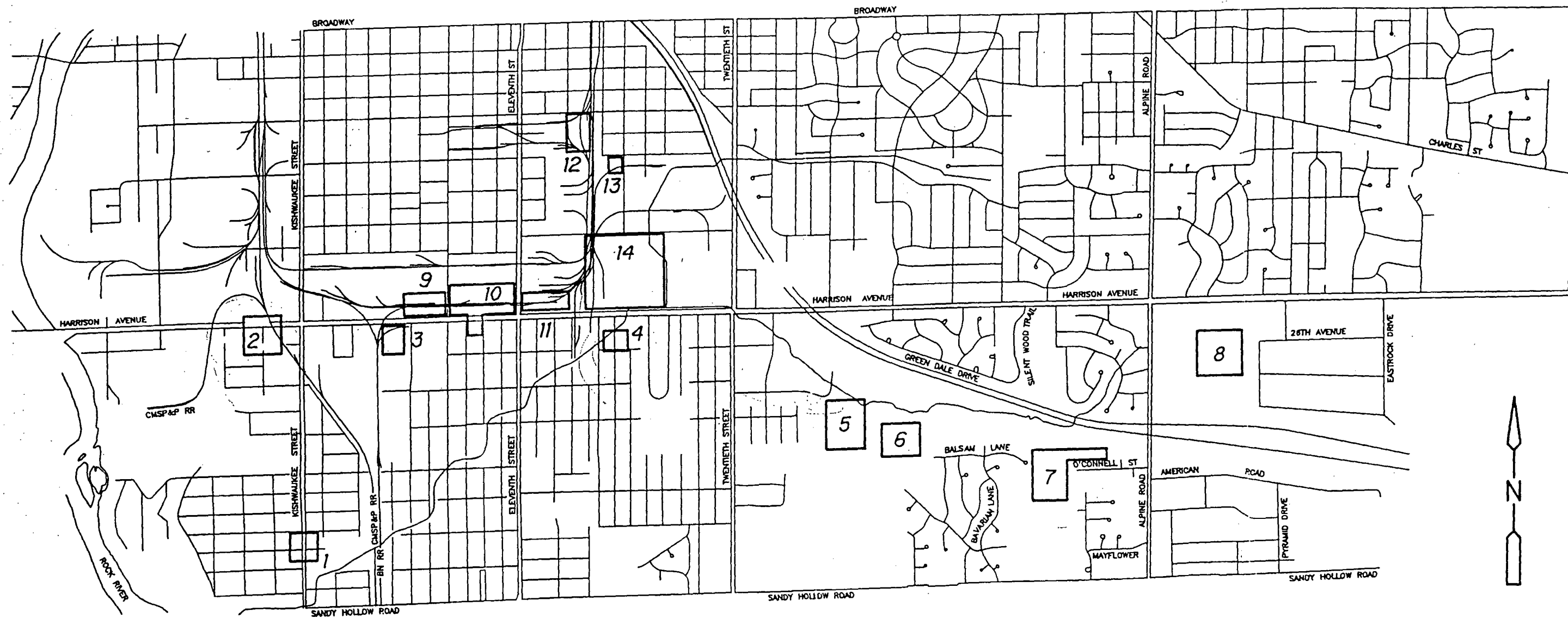
The two major areas of organic groundwater contamination, described above, may originate from separate sources, based on the apparent spatial separation of the contaminant plumes.

The fingerprints of the other contaminant plumes west and southwest of MW20 are different from those located in the two major contaminated areas. These fingerprints (based on the relative concentrations of the most abundant contaminants) are consistent with the existence of nearby potential contaminant sources in the soil, as suggested by the Phase I soil gas survey results, further discussed in subsection 2.2.3.

As a result of the Phase I sampling, groundwater modeling, and soil gas survey work, several potential source areas were identified at the site. Potential source areas are located as shown on Figure 2-2 and are labelled Areas 1 through 8. Subsequent to Phase I, CDM examined information on industrial operations and defined additional potential source areas that are proposed for investigation during Phase II. These areas are labelled 9 through 14 on Figure 2-2. The information examined included IEPA files from the Rockford office, and information on facility practices provided to the USEPA by industrial enterprises, under an ongoing enforcement action. This information is summarized in the following pages. Also included in these pages is information regarding the facilities of several potentially responsible parties (PRPs) that are not proposed for Phase II soil gas or soil boring work, and are therefore not assigned numbers for potential source areas. Other investigative work will be conducted during Phase II at most of these areas, generally comprising the collection of on-site groundwater samples from existing wells at the facilities.

SWEBCO MANUFACTURING, INC. (POTENTIAL SOURCE AREA 4)

Swebco Manufacturing, Inc. at 2630 Marshall is a precision contract machining shop producing metal parts. The present management acquired ownership in 1985 under the name of Pro-Tool Manufacturing Co., then changed to Swebco Manufacturing, Inc. in 1990. The company did use a solvent, although its contents are not specified. However, naphthenic distillate petroleum, hydrocarbons, and mineral spirits are all components of compounds used at the facility. There are three underground tanks present, in unknown condition. They are thought to be currently empty, but their past contents were fuel oil and waste oil. The area around the tanks was sampled once, indicating benzene, toluene, ethylbenzene and xylene



SOUTHEAST ROCKFORD
PROPOSED PHASE II
SOIL GAS AREAS

Figure No. 2-2

(BETX) contamination. When asked about past releases, Swebco described two spills of water-soluble coolant. However, Swebco is also involved in a legal dispute with Kenroth Manufacturing, Inc., and the Cherry Valley Bank. The bank is suing Swebco on a number of counts, including that they are damaging the property (the bank's collateral) "by negligently and unlawfully dumping contaminants and toxins such as oil and other chemicals on said real property." This complaint is based on alleged oil-dumping incidents near the chip bin. The Phase II work proposed for the Swebco area comprises soil gas and soil boring work, the installation of a downgradient monitoring well, and the sampling of existing upgradient monitoring wells. Further details on this proposed work are given in Section 3.

SUNDSTRAND (POTENTIAL SOURCE AREAS 8 AND 10)

Sundstrand operates out of a number of different locations. Plants 1, 6, and 8 of Sundstrand present reason for environmental concern. Also worth noting are storage sheds at 1400 Harrison Avenue at which TCA and/or PCE mixed with oil were routinely used as weed killers from 1962-1980.

Plant 1 at 2421 11th Street is used for the manufacture of aircraft parts for constant speed drives. TCA is produced as a waste solvent at this facility. There were numerous reported spills of JP-4 jet fuel, mineral spirits and waste oil.

Plant 6 at 4747 Harrison Avenue was constructed in 1967. It is used for the testing, assembly, and research and development of aerospace components. TCE was used at the facility until 1979. In 1984, an estimated 600-800 gallons of toluene was released from an underground storage tank. Toluene concentrations in the groundwater reached as high as 591 ppm. A toluene remedial action program was begun. During the investigation into this release, TCA, PCE, TCE, and 1,1-DCE contamination was discovered. It is possible that the contamination was related to USTs that had previously stored TCA, PCE, and other oils and solvents.

In another area of the facility, three other USTs (one had held waste TCA) had been removed in 1986, and were discovered to have had holes. The soil in this removal was contaminated with TCA and PCE up to 1,100 ppm. There are also some miscellaneous incidents in the files available for review: a release of an unknown volume of PCE in 1987, a 1990 analysis of soil showing 6.3 ppm PCE, and a 1990 explosion which led to the release of a small amount of TCA vapor, which may have been cleaned up before release into the environment.

Plant 8 is used for the testing of various aerospace components. There is an afterburner tank that intermittently overflowed from 1966-1979, spilling waste water with possible traces of hydrazine and solvents to a field south of Plant 8. Other spills of acids and bases, ethylene glycol, and JP-4 also took place. In July 1990, a waste oil tank located near the southeast corner of the Plant 8 building, overflowed. Soil samples during the subsequent investigation indicated 190 ppb TCA, 230 ppb PCE, and PAHs at up to 22,000 ppm.

The Phase II work proposed for Sundstrand facilities includes soil gas and soil boring work near Plant 1 and near the storage sheds at 1400 Harrison Avenue.

ROCKFORD COATINGS CORPORATION (POTENTIAL SOURCE AREA 11)

Rockford Coatings Corporation discontinued operations at 1620 Harrison Avenue in 1983. The company manufactured paint products of different colors and types, including air-dry and baking enamels, lacquers, and water-based paints. Use of chlorinated solvents at the facility is unknown. All solvents were stored in above-ground tanks. Waste from the facility was handled by Acme Solvents in the early 1980s. The Phase II work proposed for the Rockford Coatings area includes soil gas and soil boring work, the installation and sampling of new monitoring wells, and the collection of samples from existing monitoring wells.

ROCKWELL INTERNATIONAL GRAPHICS (POTENTIAL SOURCE AREA 11)

Rockwell International Graphics at 2524 11th Street manufactured gears and rollers for newspaper presses from 1974 to approximately 1991. The facility used 1,1,1-trichloroethane for cleaning rollers until 1983. There is little information regarding this piece of property; however, a railroad right-of-way is located adjacent to the property, to the south. This land is owned by Aetna Plywood. There was an environmental assessment performed on the property, which indicated some areas of concern. One such area was a section of stained soil adjacent to a concrete slab on Rockwell Graphics property. It appeared that a Rockwell Graphics dumpster had leaked cutting oils onto the ground surface. A grab sample of soil indicated 15,900 ppm TPH. TCE was detected in this area at 21.3 ppb. A monitoring well (MW-3) placed in this area indicated 2.5 ppb PCE, 36.6 ppb TCA, and 7.4 ppb TCE. Also, a pit to the north of Rockwell Graphics property contained standing water with an oily sheen; a soil sample adjacent to this pit contained 460 ppm TPH. Other areas of concern in this right-of-way (but not adjacent to Rockwell Graphics property) are a bunker, reportedly used by Rockford Varnish Company, that was seeping a tar-like substance. A monitoring well (MW-2) in this area indicated 1,150 ppb TCA, and 302 ppb TCE. A second area was the portion of the right-of-way with above-ground tanks, possibly the property of the RN Transportation Group, some of which held PCE and TCA. A monitoring well (MW-1) in this location did not indicate contamination from chlorinated solvents, but did show a concentration of toluene at 604 ppm. Phase II work proposed for the area of Rockwell Graphics facility includes soil gas and soil boring work, monitoring well installation, and sampling of existing on-site wells.

VIKING CHEMICAL (POTENTIAL SOURCE AREA 12)

Viking Chemical Company is located at 1827-18th Avenue. A visual inspection conducted while driving past this facility showed the existence of approximately 15 large (approximately 5,000-gallon capacity) above-ground storage tanks that hold a variety of compounds, including some site contaminants of concern (TCA and PCE). The facility is also located

1,500 feet east-southeast (roughly upgradient) of the municipal wells UW-7 and UW-7A, which have been abandoned because of VOC contamination. As of this writing, no requests for information have been submitted to Viking by USEPA. The Phase II work proposed to be conducted at this location comprises soil gas and soil boring work.

ACME SOLVENT RECLAIMING, INC. (POTENTIAL SOURCE AREA 13)

Acme Solvent Reclaiming, Inc., located at 1915 20th Avenue, was founded in 1955. They operated until 1986 as a business that recycled contaminated solvent wastes. They were permitted to handle a number of solvents, including chlorinated organics. In a 1980 permit they stated that they handled 2,000,000 gallons of various solvents a year. The facility had a history of spills, leaks, and poor housekeeping. It was reported that approximately 47 rusting, bulging drums were stored at the facility for three years after its closing. Soil samples taken at a depth of 9'3" under the floor of the building indicated 590 ppm TCA and 226 ppm TCE. A water sample from a nearby deep well indicated no contamination.

Highlights of subsequent sampling events included tank scrapings which had 2,700 ppm TCA, 1,700 ppm PCE, and 130 ppm TCE. Water samples from the monitoring wells installed by IEPA indicated 910 ppb TCA, 620 ppb TCE, and 290 ppb PCE. The Phase II work proposed for the Acme facility includes soil gas and soil boring work and the collection of groundwater samples from on-site monitoring wells.

BORG-WARNER (POTENTIAL SOURCE AREA 14)

Borg-Warner, formerly at 2020 Harrison Avenue, was a universal joint manufacturing facility that operated from 1938 to 1986. The facility was sold in 1988 to Superior Toy and Manufacturing Company, Inc. During Borg-Warner's operations, steel was processed into finished products including steel bearings, slip joints, universal joints, and metal drivelines.

Chlorinated solvents used at the facility included chloroethane (observed during an inspection of the facility), and trichloroethylene and 1,1,1-trichloroethane (information from manifests).

Incidences and practices which may have contributed to contamination include alleged dumping of oily sludges along the west side of the northern tract of the facility, disposal practices at a possibly unlined chip pit, and numerous tanks at the facility. Past soil sampling at the chip pit indicated 1,020 ppm cis-1,2-DCE, 627 ppm 1,1-DCA, 111 ppm PCE, 150 ppm TCA and 75 ppm TCE. Soil sampling near the tanks indicated 18.4 ppb PCE and 13.2 ppb TCA. Initial sampling at a monitoring well installed in 1988 indicated 20 ppb TCA. The Phase II work proposed for the Borg-Warner facility includes soil gas and soil boring work, monitoring well installation (contingent on soil gas results), and sampling of existing on-site wells.

ERHARDT & LEIMER

Erhardt & Leimer, located at 4960 28th Avenue, was originally called General Web Dynamics until January 1991. It is unknown when the company was founded. Erhardt & Leimer is a light industrial metalwork company that performs machine painting, testing, and production. A release of TCA took place prior to the fall of 1984, but there was no additional information regarding this incident in the files available for review. There was also a complaint of alleged dumping of waste TCA and oil on the ground for a six-month period in 1986, but IEPA never discovered any evidence of this practice. The facility ceased use of TCA in its plate cleaning dip tank in March of 1988.

There were three areas of the site targeted for soil excavation in the mid-1980s. The first was the former drum storage area on the western side of the building where a floor drain near the TCA storage tank was discovered to be leaking. Sampling performed in 1986, presumably pre-excavation, revealed TCA contamination of 54.8 ppb. Approximately 23 cubic yards of soil were excavated in 1987. There were no clearly indicated post-excavation results available in the file for review.

A second area of concern was located at the southeast corner of the building at the location of monitoring well 1D. In 1986, pre-excavation, contamination levels were 25 ppm TCA

and 2.1 ppm PCE. Approximately 222 cubic yards of soil were excavated and manifested for disposal in 1987. Post-excavation sampling in 1987 indicated 2.6 ppm TCA. Then, in June 1988, 20 additional cubic yards of soil were removed and manifested. This additional cleanup was performed in order to achieve 1,2-dichloroethane soil concentrations below 100 ppb.

A third area at the northeast side of the building contained oil-stained soils. Soil sampling in this area in 1986 indicated 1,190 ppm TCA and 197.0 ppm 1,1-DCE. Approximately 10 cubic yards of soil were excavated in this area in 1987, but no post-excavation sampling results were given. However, soil sampling performed in 1988 indicated 136 ppb PCE, 3.6 ppb TCE and 2.1 ppm TCA.

Numerous monitoring wells have been installed on the premises. Initial concentrations of TCA in the groundwater were greater than 1 ppm in 1986; a comprehensive monitoring program was begun in 1988, and these wells are monitored quarterly. Well 14D had shown a TCA increase in May 1991. The most recent data from these wells, measured in September 1991, indicate TCA levels at 560 ppb and PCE levels at 160 ppb.

The Phase II work proposed for the Erhardt & Leimer facility consists of the collection of groundwater samples from an existing on-site monitoring well, and from one off-site (Sundstrand) monitoring well. These samples will allow assessment of the extent of downgradient contaminant migration from this recent incident.

ESTWING

Estwing, located at 2647 8th Street since 1928, manufactures hand tools such as hammers, hatchets, and pry bars. TCA is used as a lubricant, in the form of an aerosol from 16-ounce cans. Approximately 24 of these are used per year. From 1982 to 1987 it was alleged that waste paint-related materials (solvents, thinners, and paints) were disposed of in an on-site pit at the back of the facility. An IEPA FIT investigation found soil concentrations of TCA

and PCE to be 2 ppb each. Some semivolatile compounds were detected at 9.6 ppm. Groundwater samples from the production well (sampled in June 1990) contained 528 ppb TCA, 533 ppb 1,1-DCA, and 110 ppb 1,1-DCE. The Phase II work proposed for the Estwing vicinity consists of the installation and sampling of upgradient monitoring wells, and the collection of a groundwater sample from the existing on-site production well, if still accessible.

ROCKFORD PRODUCTS

There are two plant locations for Rockford Products: Plant 2 is located at 612 Harrison, and Plant 3 is located at 707 Harrison.

Plant 2 is engaged in the zinc plating, packaging, and shipping of cold-formed steel products, primarily bolts, screws and nuts. There is no specific mention in the files available for review of the use of chlorinated solvents, except for the production of TCE waste from cleaning agents. There were a number of storage tanks onsite, and sampling at one above-ground tank indicated 775 ppb PCE.

Plant 3 was constructed in 1954 to manufacture screws, bolts, and metal fasteners. For a nine-year period beginning in 1976 it operated under the name Rexnord. TCE was used as a degreaser at the site prior to 1980. TCA was also used at the site; in 1985, 220 tons of TCA were purchased, and in one year at least 120 tons of TCA were emitted from the stacks of the degreasers, in excess of the permitted 20 tons. This TCA may have subsequently condensed, fallen onto the roof and drained toward the seepage pit discussed below.

A one-acre seepage pit, created in the 1950s, has been the center of environmental concern at the facility. It was used to collect storm and cooling water, but has also been used for the disposal of waste oil (the sides of the pit were observed to be coated with oil), as well as many other wastes. TCA vapor, emitted from a stack on the roof, condensed onto the roof and eventually the contamination was washed into the pit. Also, a contaminated production

well (one sample indicated 200 ppb TCA) is used to supply cooling water which is eventually discharged into the pit. Surface water samples of water in the pit in 1984 indicated 66 ppb TCA, 66 ppb TCE, and 6 ppb PCE.

Monitoring well samples collected in 1985 confirmed that contamination was present in the groundwater, indicating up to 199 ppb TCA and 452 ppb TCE; subsequent samples from these wells had considerably lower concentrations (less than 40 ppb of each compound). Soil samples taken in 1989 indicated 70 ppb TCA adjacent to the pit. Aside from the pit, there is also a landfill and UST on site. And in 1986, approximately 50-100 gallons of TCA was spilled onto the roof, and drained into an open ditch on the property. TCA, however, was not detected in subsequent soil samples.

The Phase II work proposed for the Rockford Products facilities consists of the collection of groundwater samples from one production well and from one existing monitoring well, both at the Plant 3 location.

SUNTEC INDUSTRIES, INC.

The Suntec facility at 2210 Harrison Avenue was formerly a Sundstrand facility involved in the manufacture of fuel oil pumps until 1984. At that time the business was purchased by Suntec (although the title to the property remained with Sundstrand) and the facility was used for the manufacture of printed wiring boards, and for photo operations. There is little specific information as to what solvents were or are used at the site. There were a number of USTs which contained Stoddard solvent and oils. Although historically these tanks (twelve USTs and two AGSTs in a vault) were not supposed to have contained chlorinated solvents, a soil gas survey in 1989 indicated the presence of such compounds, including TCE, TCA, and PCE. Groundwater samples indicated 110 ppb PCE, 190 ppb TCE, and 420 ppb TCA. Subsequent soil borings adjacent to tanks which had contained machining oils yielded soil samples containing 62 ppm TCA, 38 ppm TCE and 25 ppm PCE. The Phase II

work proposed for the Suntec area is the collection of groundwater samples from on-site monitoring wells.

2.2.3 PHASE I SOIL GAS SURVEY

A soil gas survey was conducted during Phase I between May 13 and June 6, 1991, for the purpose of identifying areas of soil contamination, and locating potential source areas in the study area. Previous groundwater sampling conducted during the Operable Unit phase defined the existence of small plumes of groundwater contamination which are chemically distinct from the two larger contaminated areas. These smaller plumes were the focus of the Phase I soil gas survey. The Phase I survey provided concentrations of TCA, TCE and PCE in soil gas samples, and showed soil gas hits which correlate with the small contaminant plumes; this correlation is based on similar contaminant fingerprints in the soil gas and in the associated groundwater plumes located just downgradient. For instance, several soil gas samples in soil gas area 4 showed elevated TCA concentrations (up to 3400 ug/l), while TCE and PCE were closer to background concentrations (up to 180 and 14 ug/l, respectively). This pattern of TCA-TCE contamination was present in a 1990 Operable Unit sample located approximately 1000 feet roughly downgradient (west-northwest) from the soil gas hits. As a result of the Phase I work, the areas with elevated contaminant concentrations in soil gas were named potential source areas in the Phase I report.

Owing to the high contaminant concentrations (> 10 ppm total volatiles) found in the shallow part of the unconsolidated aquifer at well MW106A in Phase I, an addendum to Phase I work was conducted across area 7 in May 1992. This work was conducted from May 26 to 29, 1992, and comprised both geophysical surveys (terrain conductivity and ground-penetrating radar) and soil gas sampling. The soil gas sampling conducted at this time showed extensive areas underlain by elevated concentrations of each of the target compounds (up to 3,800 ug/l 1,1,1-trichloroethane, up to 1,100 ug/l tetrachloroethene, and up to 690 ug/l trichloroethene); budget constraints prevented complete definition of the area underlain by elevated contaminant concentrations in soil gas. Further soil gas sampling is proposed for Phase II in

area 7, in order to more completely define the VOC-contaminated area. As discussed in more detail in subsection 3.3.2, additional soil gas work is proposed for Phase II in several of the areas identified as potential sources in the Phase I report (areas 1, 2, 3, 4, 5 and 7). Also, as outlined above and discussed in subsection 3.3.2, soil gas work is proposed in several additional potential source areas (areas 9 through 14) identified through the existing information review.

3.0 GENERAL SAMPLING INFORMATION

3.1 SAMPLE CONTAINERS

Soil Gas Samples

Soil gas samples will be collected in a 2-cc sterilized glass syringe, and injected into the gas chromatograph. Syringes will be sterilized by pretreating them daily in a high-temperature oven. The 2-cc syringes will be used only once prior to decontamination. Further details of soil gas sampling are discussed in subsection 5.1.

3.2 DOCUMENTATION

This section outlines the documentation required for soil gas survey activities to be conducted during the Phase II Remedial Investigation.

3.2.1 FIELD LOG BOOKS

Field log books will provide the means of recording pertinent data collected during the performance of RI activities. As such, entries will be described in as much detail as possible so that site personnel can reconstruct a particular situation without reliance on memory.

Field log books will be bound, field survey books. Log books will be assigned to field personnel, but will be stored in the document control center when not in use. Each log book will be identified by the project-specific document number.

The title page of each notebook will contain:

- Person or Organization to whom the book is assigned;

- Book Number;
- Project Name;
- Start Date; and
- End Date.

Entries into the log book will contain a variety of information. At the beginning of each entry, the date, start time, weather, name of all team members present, level of personal protection being used, and the signature of the person making the entry will be recorded. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will be recorded in the field log book. At the end of each day's activity, the log will be closed with the time and signature of the person making the last entry (log-closed line). The log-closed lines and the following log-open lines will be placed so that no unauthorized entries can be made between entries. A typical format is presented in Figure 3-1.

Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Wherever a sample is collected or a measurement is made, a detailed description of the location of the station, which may include compass and distance measurements, shall be recorded. The number of the photographs taken of the station with a brief description including the direction faced will be noted. All equipment used to make measurements will be identified, along with the date of calibration.

The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample location identifiers will be assigned prior to sample collection. Duplicate samples will be noted under sample description.

Figure 3-1
TYPICAL FIELD NOTEBOOK ENTRY FORMAT

LOG-OPEN TIME: _____ DATE: _____
SIGNATURE: _____
WEATHER: _____

FIELD PERSONNEL: _____

LEVEL OF PERSONAL PROTECTION: _____

EQUIPMENT (NAME/CONTROL NO.): _____
_____ Calibration Date: _____

Station No./Location Description: _____

Film Roll Number: _____ Photograph Numbers: _____
Station No. (Parameter (Units))

Sampling Equipment: _____

<u>No.</u>	<u>Time</u>	<u>Sample Description.</u>	<u>Depth</u>	<u>Number</u>	<u>Volume</u>	<u>Chest No.</u>	<u>Comments</u>
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

3.2.2 SAMPLE IDENTIFICATION SYSTEM

Each soil gas sample will be assigned a sample location ID. The first two letters of the sample location ID denotes the sample matrix. The code for the soil gas sample matrix is SG. The first digit in the sample location ID will indicate the soil gas area (as shown on Figures 4-1 through 4-11) and the two digits after the dash will denote the consecutive sample number collected within that soil gas area. The first letter suffix will detail the sample depth in 5-foot intervals. Letter "A" will represent a near-surface sample, "B" a five-foot sample, etc. An example is as follows:

SG6-01B(D)

This designation shows that this soil gas sample was collected from area 6 at location 01 at a depth of five feet. (Nearly all soil gas samples will be collected from a depth of five to seven feet.)

A final one-letter suffix in parentheses will be added for duplicate or field blank samples. For instance, SG6-01B(D) would represent a duplicate collected for soil gas sample SG6-01B; the suffix "(R)" would represent a field blank for a soil gas sample. Sample designations will be recorded in the sample field book.

4.0 SAMPLE LOCATIONS AND RATIONALE

Data from Camp Dresser & McKee's (CDM) Phase I Investigation (June to October 1991) indicates two major areas of groundwater contamination of volatile organic compounds (VOCs) located within the Phase I study area. According to the Phase I results, 1) significant levels of 1,1,1-trichloroethane (TCA), 1,1-dichloroethane (1,1-DCA) and 1,1-dichloroethene (1,1-DCE) were detected in groundwater in an area centered near the industrial facility southeast of the intersection of Harrison Avenue and Alpine Road, and 2) significant levels of TCA, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE) and 1,1-DCA were detected in groundwater in a large area near and downgradient (west-northwest) from well nest MW106. Near the downgradient extent of this larger area of contamination, there are several smaller areas of contamination located west and southwest of MW20, indicated by the presence of TCA, TCE, PCE, cis-1,2-DCE, 1,1-DCA, and 1,1-DCE.

As discussed in the Phase I Technical Memorandum, the Phase I groundwater and soil gas sampling results suggest potential source areas corresponding to the significantly contaminated locations in the following areas: 1) upgradient from well nest MW106 (Area 7); 2) upgradient from well nest MW101 (Area 5); 3) at the industrial facility southeast of Harrison Avenue and Alpine Road (Area 8); and 4) several discrete locations in industrial areas in the western part of the study area (areas 1 through 4). Area 6, like Area 5, is located upgradient of MW101, and was originally considered a potential source area because of its location and land use (a large, shallow excavation). However, aerial photographs recently obtained indicated that the period of suspect land use occurred only after 1980; as a result, Area 6 is no longer considered a potential source area, and will not be investigated further.

As stated in the Phase I RI Work Plan, a more extensive and comprehensive investigation of the above-mentioned contamination problems in the study area will be addressed during the

Phase II RI. The soil gas survey outlined in this plan will constitute a major portion of the Phase II source investigation.

4.1 SOIL GAS SURVEY

The Phase II soil gas survey will be conducted to delineate areas of soil contamination and to aid in identifying source areas that may have contributed to the groundwater contamination that exists in Southeast Rockford. As shown in Figure 2-2, twelve specific areas across the study area will be tested for soil gas constituents during Phase II. Approximately 212 locations will be tested in these twelve areas. The areas to be surveyed for soil gas constituents have been identified as potential source areas based on the results of groundwater sampling conducted during the Operable Unit phase and during Phase I of this study; the results of soil gas work conducted in Phase I; and other information including aerial photographs, site visits, previous IEPA or USEPA studies, and information regarding industrial activities in the study area. Five of the areas shown on Figure 2-2 (areas 1, 2, 3, 4, and 7) were surveyed for soil gas constituents in Phase I or during the Source Area 7 screening, during which one or more survey locations in each area showed anomalous results (TCA, TCE, or PCE present at concentrations of 1 ug/L or greater). These results will be verified in the Phase II soil gas survey, and the boundaries of areas with likely soil contamination will be more precisely outlined. (The portion of Area 5 to be surveyed in Phase II is several hundred feet south of the portion surveyed during Phase I.) Following the soil gas survey, soil borings will be advanced in each of the soil gas areas (during Phase II drilling work conducted in 1993), in order to collect soil samples to verify the existence and extent of soil contamination. This work will be specified in separate work plan documents.

The other seven soil gas survey areas were selected on the basis of groundwater sampling results combined with aerial photographs or other information. For instance, area 5 was selected for soil gas study because: 1) it is located a short distance hydraulically upgradient from the highest contaminant concentrations detected in any groundwater samples in the Southeast Rockford area (at MW101B, which contained 12 ppm TCA in the Phase I sample);

2) aerial photographs show extensive linear scars that may indicate trenching and dumping of hazardous substances for several years near and after 1958; and 3) the area was devoid of vegetation between at least 1958 and 1970. The specific rationale used in selecting each of the Phase II soil gas survey areas is given in Table 4-1; approximate locations of specific soil gas survey points are shown in Figures 4-2 through 4-11. As for the five areas mentioned above, follow-up work for the other seven areas will be conducted later in Phase II. This work will consist of drilling and sampling subsurface soils, and installation of upgradient and downgradient monitoring wells. This work will enable definition of the existence and extent of soil contamination, and assessment of the likelihood of each area constituting a source area for groundwater contamination.

Owing to the high contaminant concentrations (> 10 ppm total volatiles) found in the shallow part of the unconsolidated aquifer at well MW106A in Phase I, a screening level survey to identify subsurface anomalies and VOCs in soil gas was conducted across area 7 in May 1992 (Appendix A). This work was conducted from May 26 to 29, 1992, and comprised both geophysical surveys (terrain conductivity and ground-penetrating radar) and soil gas sampling. The soil gas sampling conducted at this time showed extensive areas underlain by elevated concentrations of each of the target compounds (up to 3,800 ug/l 1,1,1-trichloroethane, up to 1,100 ug/l tetrachloroethene, and up to 690 ug/l trichloroethene (see Figure 4-1); budget constraints prevented complete definition of the area underlain by elevated contaminant concentrations in soil gas. Further soil gas sampling is proposed for Phase II in area 7, in order to more completely define the VOC-contaminated area. The results of this work will assist in selecting locations for soil borings and monitoring wells to be installed later during Phase II.

Specific soil gas sample locations within the soil gas survey areas will be determined in the field based on access and the locations of any underground utilities. Such considerations will likely eliminate some of the locations shown in Figures 4-2 through 4-11. However, it is likely that additional locations beyond those shown in the figures may be tested for soil gas, based on the locations of elevated concentrations of the target compounds (TCA, TCE, and

PCE); such locations will be selected in order to define the highest contaminant concentrations in an area, or to delineate the boundaries of the area with elevated contaminant concentrations. For planning purposes, it is assumed that the number of sample locations lost due to access and utility considerations will be balanced by the additional sample locations used to define areas of high contaminant concentrations.

Soil gas samples will be analyzed for the target VOCs TCA, TCE, and PCE, based on the abundance of these compounds as groundwater contaminants throughout much of the Southeast Rockford study area. Nearly all other groundwater contaminants in the study area are common products of the degradation of TCA, TCE, and/or PCE. Soil gas points will generally be located at 50' to 200' intervals on grid patterns. The depth of the soil gas probe may vary depending on the depth to groundwater; however, it is anticipated that the sample depth will generally be in the range of five to seven feet. Where possible, soil gas samples showing elevated target compound concentrations will be followed up with additional nearby soil gas samples to define the boundaries of the zone with elevated soil gas concentrations (greater than about 1 to 5 ug/L). Locations of individual soil gas points will be determined in the field based on access, underground utility locations, and other appropriate considerations.

The soil gas survey will be conducted by Tracer Research of Tucson, Arizona, under the direction of a CDM environmental scientist. The soil gas survey will be conducted using the procedures listed in Appendix B of the approved Phase I QAPP of February, 1991 and attached to this document as Appendix B.

TABLE 4-1

**RATIONALE FOR PHASE II AND
SOIL GAS WORK AT POTENTIAL SOURCE AREAS,
SOUTHEAST ROCKFORD**

Location	Soil Gas Survey Area	Proposed Soil Gas Survey Points	Rationale
Adjacent to Kennon Road and Kishwaukee Avenue	1	17	Determine existence and extent of any soil contamination by PCE and/or TCE. Wells downgradient contain elevated PCE (545 ppb) and its potential degradation products TCE and cis-1,2-DCE, and a nearby Phase I soil gas sample contained slightly elevated PCE (4 ug/l).
West of Harrison and Kishwaukee Avenues	2	12	Conduct more detailed soil gas work along with soil sampling in borings to determine existence and extent of soil contamination at this location. A Phase I soil gas sample contained 120 ug/l PCE; wells roughly downgradient contained elevated PCE and its potential degradation products TCE, cis-1,2-DCE and vinyl chloride.
West of Eighth Street and Harrison Avenue	3	3	Determine existence and extent of contaminated soils near phase I soil gas samples that showed moderate concentrations of PCE, TCE and TCA (3 to 5 ug/l). Two downgradient wells contain elevated PCE.
South of Marshall Street and Harrison Avenue	4	27	Determine existence and extent of contaminated soils near a Phase I soil gas sample that showed high concentrations of TCA (3,400 ug/l), TCE and PCE; soil gas survey will be centered on and downgradient from a metal parts manufacturing facility adjacent to the Phase I soil gas hit.

TABLE 4-1**RATIONALE FOR PHASE II AND
SOIL GAS WORK AT POTENTIAL SOURCE AREAS,
SOUTHEAST ROCKFORD**

Location	Soil Gas Survey Area	Proposed Soil Gas Survey Points	Rationale
Former utility facility (south of Laude Drive and east of 22nd Street)	5	10	Determine existence and extent of subsurface soil contamination on and near the former Northern Illinois Gas facility located approximately 1,000 feet upgradient of MW101. MW101B had the highest contaminant concentrations in Phase I groundwater samples (12 ppm of TCA). Three soil-gas points will be tested across the paved portion of the facility, where 30 above-ground storage tanks existed. Five points will be tested for soil gas constituents in the central and southern parts of area 5, located south of the paved portion. Aerial photos shows that, from at least 1958 through 1970, much of the area was devoid of vegetation. The southern portion had numerous linear trench-like scars visible throughout this time period, and is still partly devoid of vegetation; in the central portion the area devoid of vegetation reached a maximum in 1964 (approximately 250 feet square), but was considerably smaller at other times. Both areas were accessible to vehicles via roads surrounding the paved portion of the facility.
Gravel pit east of area 5	6	0	Soil gas testing and soil borings will not be conducted in this area; monitoring wells only will be installed. Recently obtained aerial photos show that only after 1979 did the area become devoid of vegetation. Due to this late date of initiation of suspect activity, it appears unlikely that potential source area 6 was actually a source of contamination to groundwater.

TABLE 4-1

**RATIONALE FOR PHASE II AND
SOIL GAS WORK AT POTENTIAL SOURCE AREAS,
SOUTHEAST ROCKFORD**

Location	Soil Gas Survey Area	Proposed Soil Gas Survey Points	Rationale
Gravel pit and disturbed areas east of MW 106	7	13	Determine existence and extent of soil contamination in a broad area roughly 500 feet upgradient (east-southeast) from MW106A, which contained 6 ppm of TCA in Phase I. In addition, soil gas samples collected during May 1992 showed elevated concentrations of each of the target compounds TCA (up to 3,800 ug/l), PCE (up to 1,100 ug/l, and TCE (up to 690 ug/l). Field observations indicate that several areas in potential source area 7 contain various types of waste materials near the ground surface. Historical aerial photos give further such evidence. Between at least 1958 and 1970, photographs show that two small valleys southeast of MW106 were likely used for disposal of various materials. These are the two areas that showed elevated concentrations of TCA, PCE and TCE in soil gas in May 1992. Further soil gas sampling is needed to define the extent of the area underlain by elevated concentrations of target VOCs.
Northwest of Ninth Street and Harrison Avenue	9	5	Determine existence and extent of soil contamination roughly upgradient of a Phase I soil gas hit of TCA, TCE and PCE in potential source area 3 and upgradient of a groundwater "hit", TCE and PCE) in ISWS well MW46.

TABLE 4-1

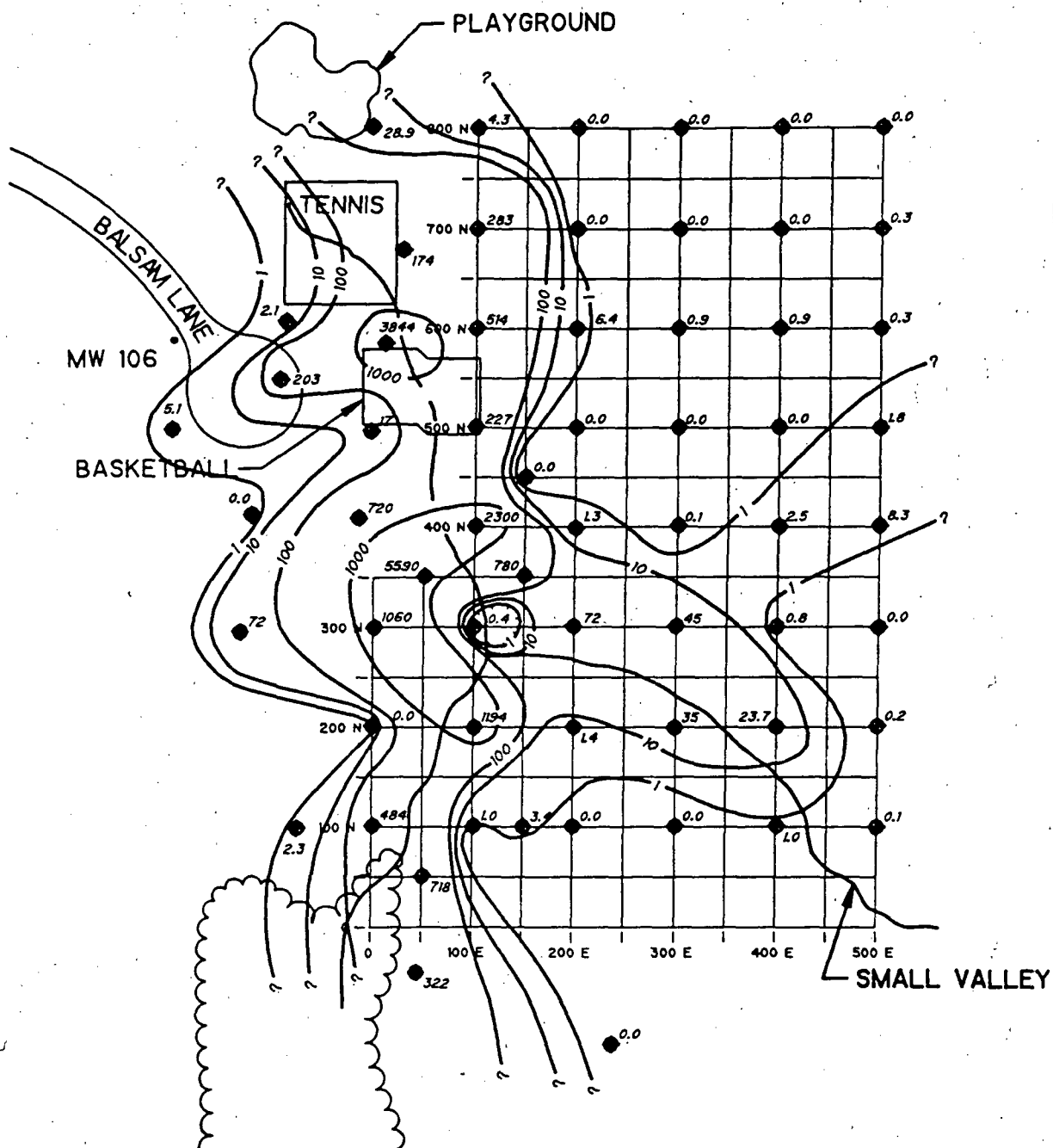
**RATIONALE FOR PHASE II AND
SOIL GAS WORK AT POTENTIAL SOURCE AREAS,
SOUTHEAST ROCKFORD**

Location	Soil Gas Survey Area	Proposed Soil Gas Survey Points	Rationale
Area surrounding Tenth Street and Harrison Avenue	10	23	Determine existence and extent of soil contamination in area roughly upgradient of MW20. This well is located in the main portion of the groundwater contaminant plume; however, compared to portions of the plume upgradient, MW20 contains higher contaminant concentrations and different contaminant ratios, suggesting a nearby contaminant source.
Northwest of Eleventh Street and Harrison Avenue	11	19	Determine existence and extent of soil contamination associated with subsurface areas previously noted to contain oily deposits at the ground surface and contaminants in groundwater. Also determine the existence of soil contamination at former facility where solvents were stored.
Southwest of Eighteenth Avenue and Fourteenth Street	12	12	Determine existence of soil contamination at this large facility which contains large solvent tanks; site is also suspected because wells roughly downgradient (Unit Well 7, MW1, MW2 and MW5) show high contaminant concentrations in groundwater (up to 3 ppm VOCs).
Southwest of 20th Avenue and 15th Street	13	5	Determine concentration and extent of soil contamination discovered in previous IEPA study.
Undeveloped land east of 2020 Harrison Avenue	14	25	Determine existence and extent of contaminated soils in this area; photos show that between 1958 and 1961 the area was the site of heavy equipment activity, with top-soil and vegetation missing across many small areas where disposal of waste may have occurred.

TABLE 4-1

**RATIONALE FOR PHASE II AND
SOIL GAS WORK AT POTENTIAL SOURCE AREAS,
SOUTHEAST ROCKFORD**

Location	Soil Gas Survey Area	Proposed Soil Gas Survey Points	Rationale
2020 Harrison	41	41	Determine existence and extent of soil contamination near location of the chip pit (which may have been unlined) and in area of potential sludge disposal to ground (adjacent to railroad).



LEGEND

- ◆ SOIL GAS SAMPLE LOCATION
- 2.3 SUM OF TCA, TCE, AND PCE CONCENTRATIONS ($\mu\text{g/L}$)
- 10— ISOCONCENTRATION CONTOUR

SCALE
50 0 100

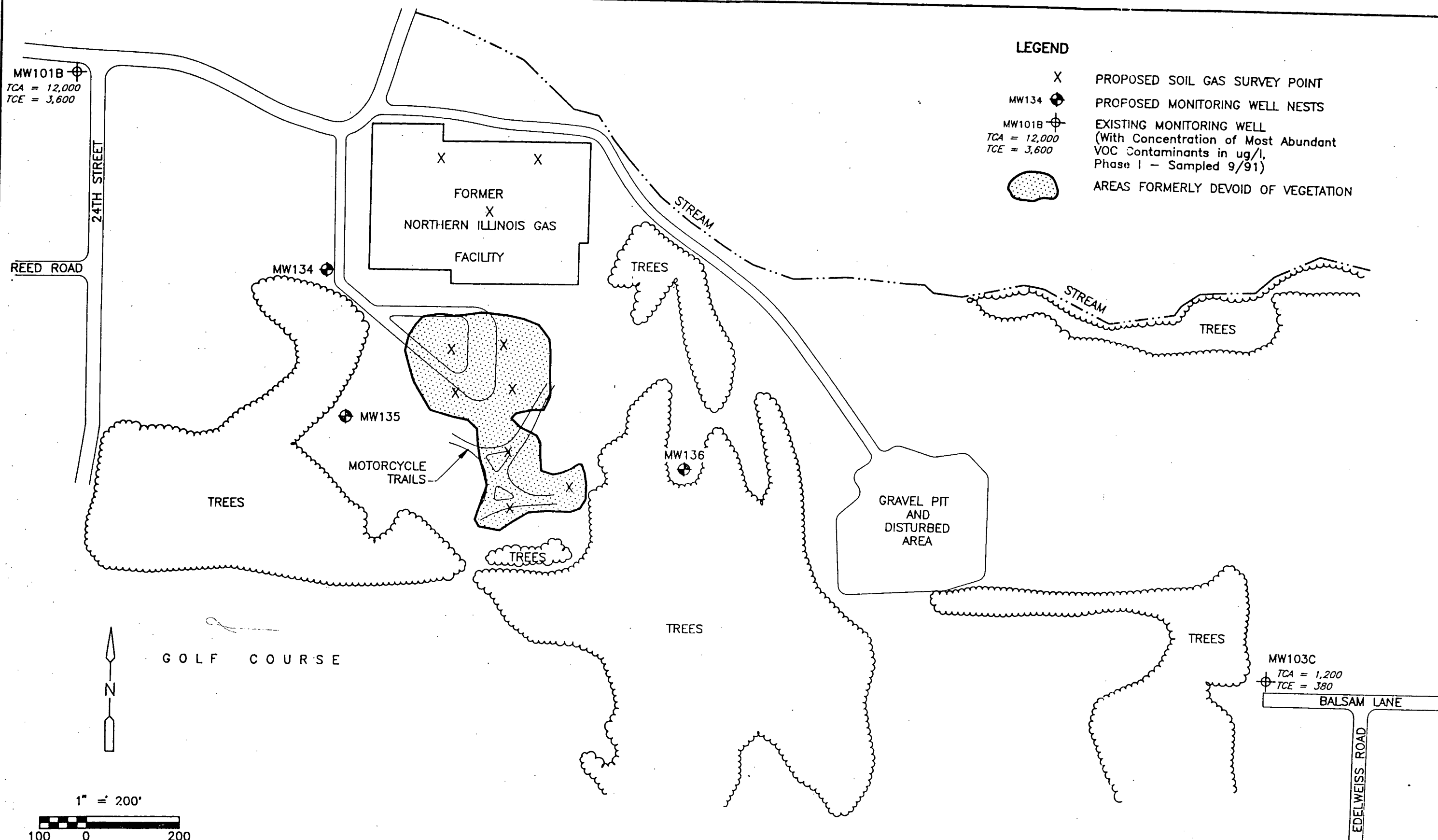
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY SUM OF TCA, TCE, AND PCE CONCENTRATIONS IN SOIL GAS POTENTIAL SOURCE AREA 7

CDM

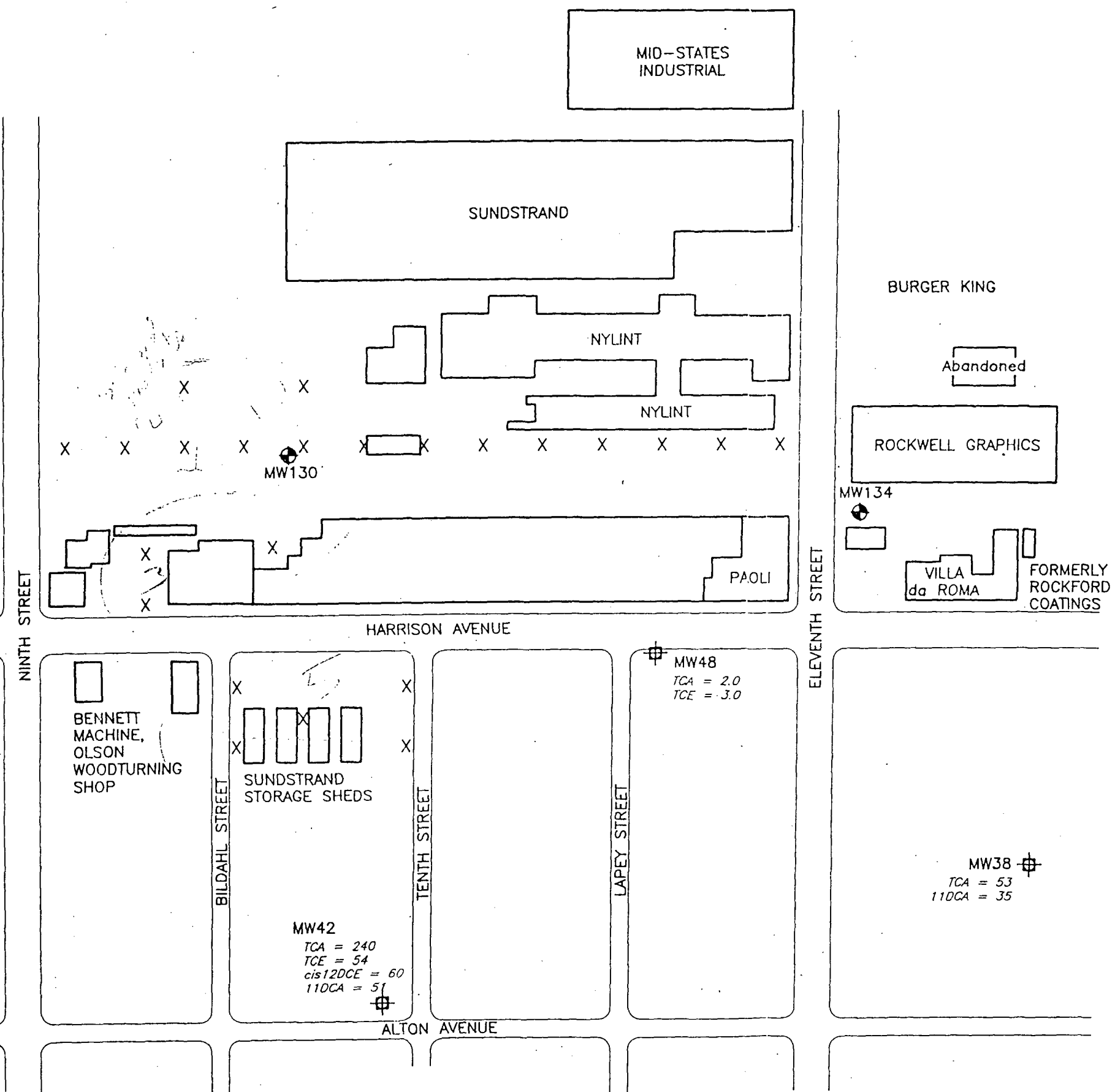
environmental engineers, scientists,
planners, & management consultants

Figure No. 4-1

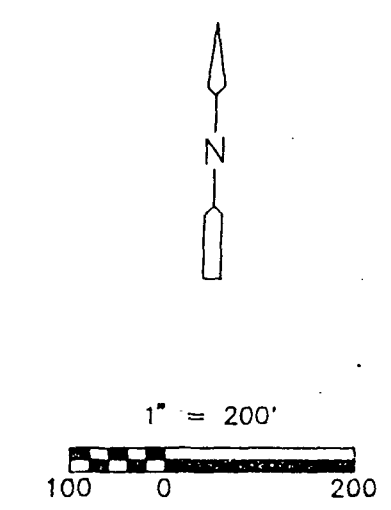
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- LEGEND**
- X PROPOSED SOIL GAS SURVEY POINT
 - MW134 PROPOSED MONITORING WELL NESTS
 - MW38 EXISTING ISWS MONITORING WELL
(With Concentration of Most Abundant VOC Contaminants in ug/l)



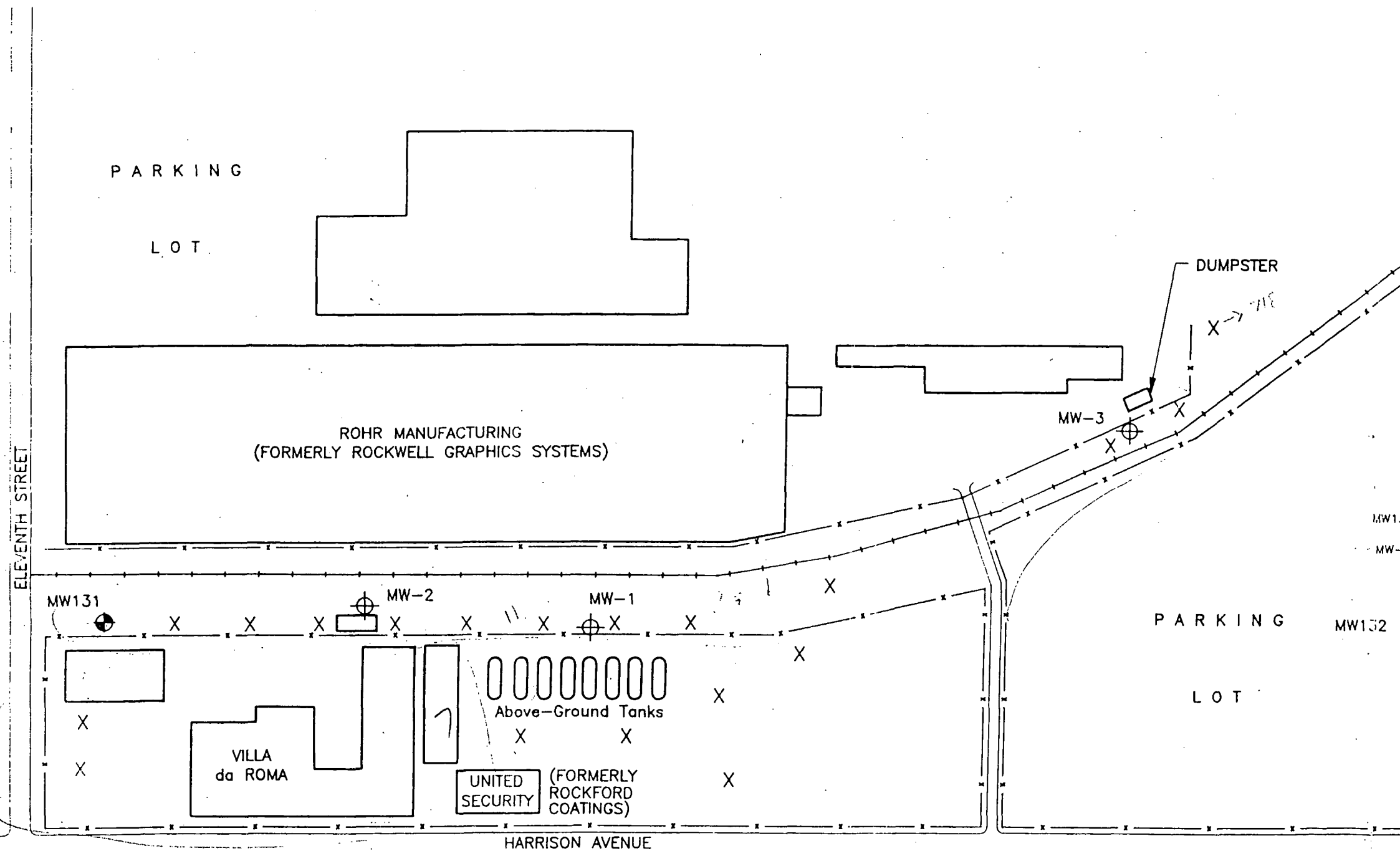
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SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

SOIL GAS SURVEY 11/14/1992

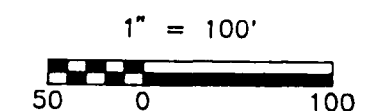
AREA 10 IEPA/DLPG

Figure No. 4-7



LEGEND

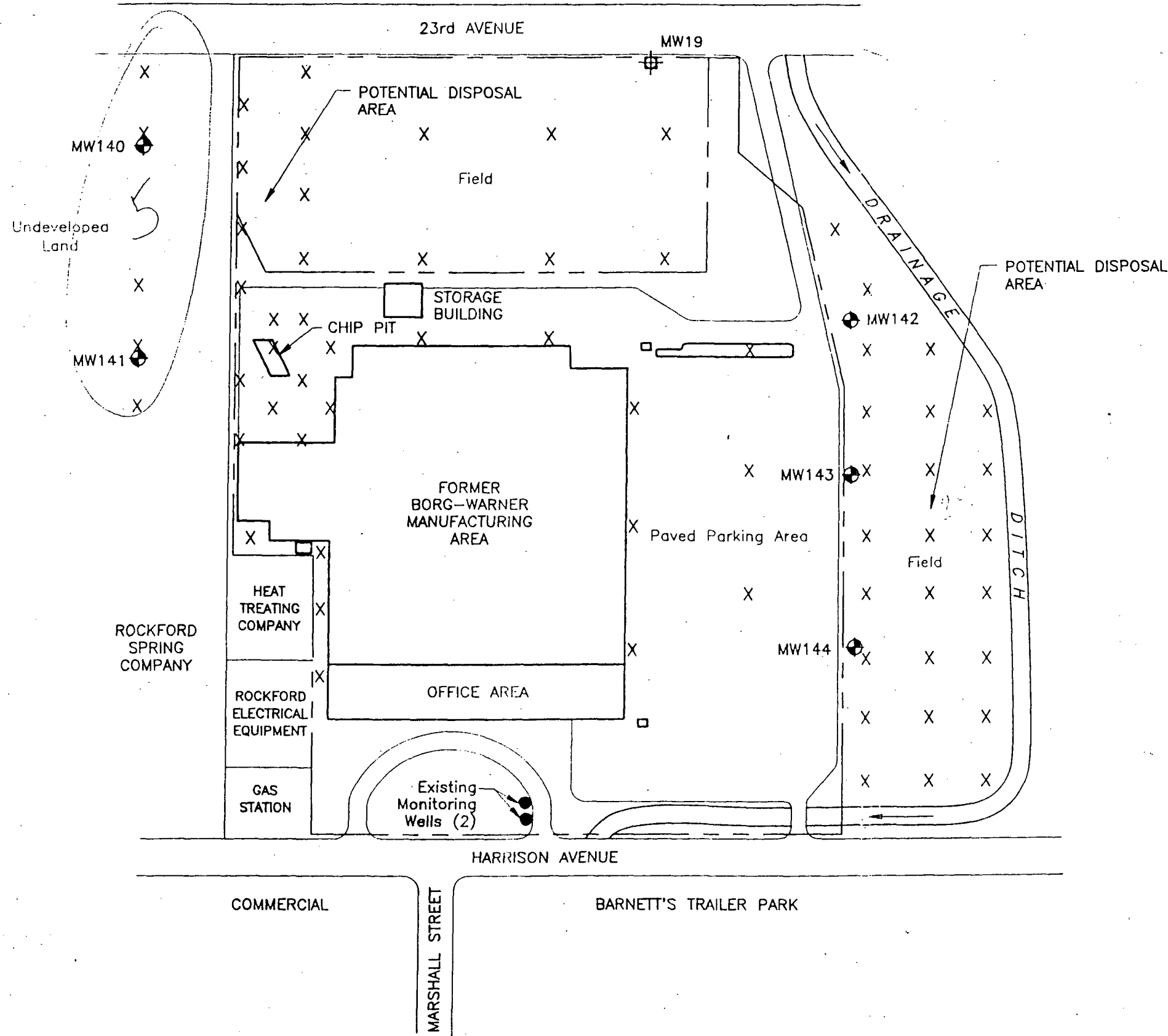
- X · PROPOSED SOIL GAS SURVEY POINT
- MW132 · PROPOSED MONITORING WELL NESTS
- MW-3 · EXISTING MONITORING WELL



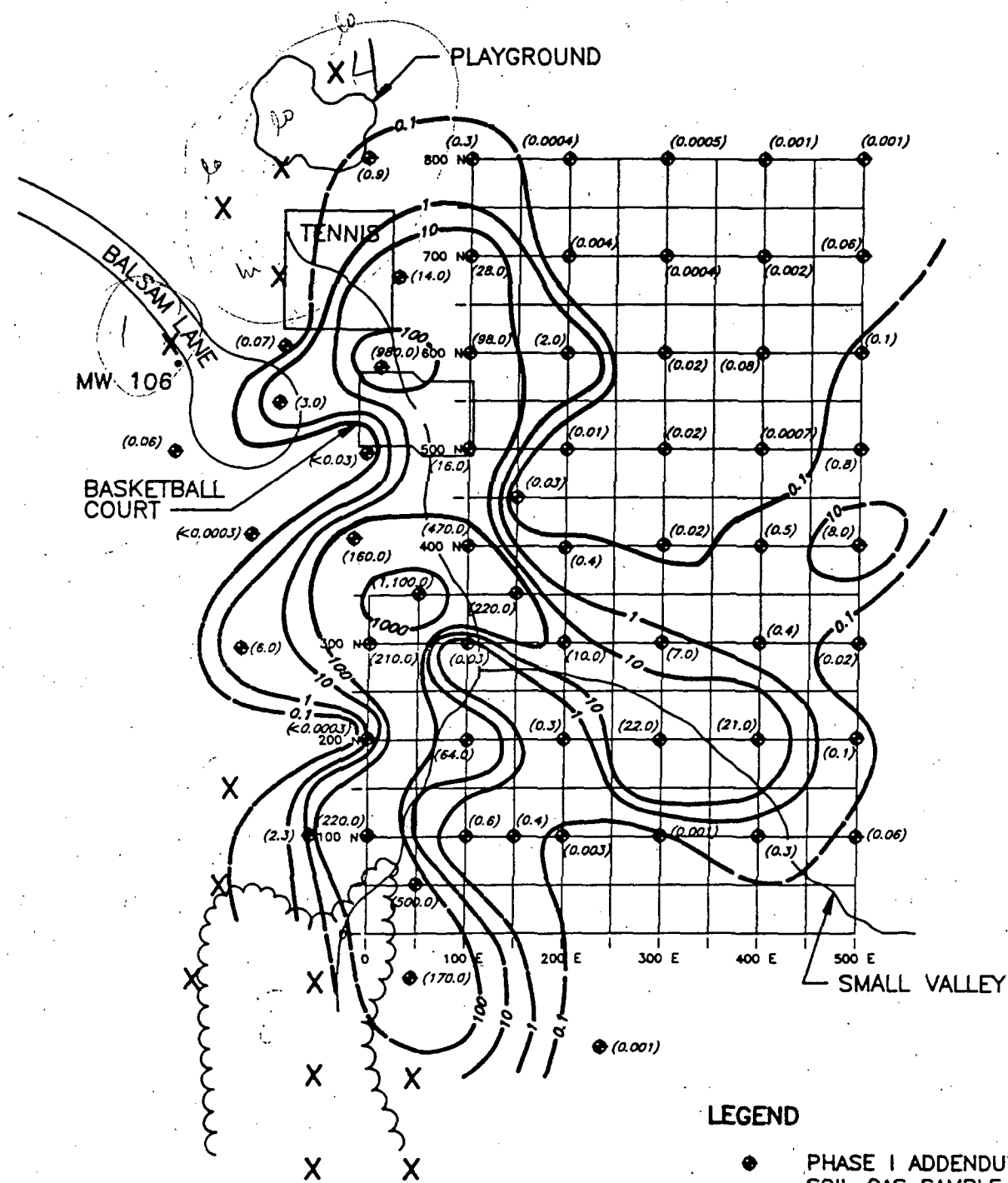
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY
SOIL GAS SURVEY
AREA 11

Figure No. 4-8

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SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY
SOIL GAS SURVEY
AREA 14



SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

SOIL GAS SURVEY
AREA 7**CDM**environmental engineers, scientists,
planners, & management consultants

5.0 SAMPLING EQUIPMENT AND PROCEDURES

5.1 SOIL GAS SURVEY PROCEDURES AND EQUIPMENT

Immediately prior to the soil gas survey, CDM will stake soil gas sample locations within the twelve soil gas areas. These staked locations will generally be based on a grid system, according to the locations shown on Figures 4-2 through 4-11 (sample spacing will generally be 50 to 150 feet). Actual sample locations will be adjusted based on building, utility and roadway locations and access agreements. During the survey, additional sample locations will be tested in order to better define areas of relatively higher VOC concentrations. These sample locations are not shown but will be determined in the field, based on the locations of elevated soil gas VOC concentrations.

The soil gas survey will be conducted by a two-person team from Tracer Research (CDM's soil gas subcontractor): one equipment operator and one data technician. The operator will set up and run the chromatograph and will be in charge of calibration and maintenance of the system. The technician will insert probes and draw air samples as well as record field conditions and sample locations. The survey will be supervised on-site by a CDM environmental scientist.

A hollow galvanized metal probe will be driven into the ground by either a hydraulic pusher/puller mechanism or hand-driven by a portable falling-head hammer to a depth of 5 feet. If there is concrete or pavement over a sample location, a Kango roto-hammer will be used to drill a 1-1/2" diameter hole through the surface material for probe access. After 3-5 probe volumes of soil gas have been purged from the driven probe using a vacuum pump, a soil gas sample will be collected in a 2cc sterilized glass syringe, and then injected into the gas chromatograph for analysis of TCA, TCE and PCE. More than two injections may be necessary where there are multiple contaminants that require different sample sizes for chromatographic analysis. Analytical procedures to be used are provided in Appendix A.

Once sampling has been completed, the probe will be withdrawn and the hole created by the probe will be backfilled with native soil or granulated bentonite. Asphalt or concrete patch will be used to cap holes that have been created in paved or concrete areas.

Equipment used to perform the survey is itemized as follows:

- One ton Ford E350 chassis, 2 or 4-wheel drive;
- Two built-in gasoline-powered generators (110 volts/AC);
- Hydraulic pusher/puller/pounder mechanism capable of driving probes 25 feet deep in some soils;
- Soil gas probes fabricated from galvanized pipe;
- Safety Equipment: first aid, fire, hazardous chemical protection;
- Two vacuum pumps;
- An electric hammer/drill capable of drilling through asphalt and assisting in driving probes;
- Personal safety equipment for Level C and Level D;
- Manual falling-head hammer;
- One Varian 3300 gas chromatograph, equipped with electron capture, flame ionization, photoionization and/or thermoconductivity detector;
- Two Spectra-Physics model SP4270 computing integrators;

- Analytical standards for purgeable priority pollutants;
- Glass syringes ranging from 10uL to 10mL in volume;
- Lap-top computer and printer for data reduction;
- Various packed and capillary gas chromatographic columns;
- Gas cylinders containing compressed nitrogen, air and hydrogen;
- 40ml glass sampling vials in which the chemical standards are prepared; and
- Various fittings and tools required for normal operation.

The procedure to be used in conducting the soil gas survey are presented in Appendix A, and in Appendix B of the Phase I QAPP. The Phase I QAPP will serve as the governing QAPP for this Phase II soil gas work.

5.2 SOIL GAS QC SAMPLES

One soil gas duplicate sample will be analyzed for every 10 soil gas samples analyzed.

Field-prepared TCE and 1,1,1-TCA standards will be analyzed at the rate of one per five soil gas samples analyzed. An ambient air sample will be analyzed at one per 15 soil gas samples. The ambient air sample and analysis will function as a field blank.

A method blank will be analyzed at the rate of one per ten analyzed soil gas samples. The method blank will consist of injecting nitrogen carrier gas into the field gas chromatograph. The method blank will serve as a check of the chromatograph for contamination derived from routine sampling.

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5.3 TECHNICAL MEMORANDUM

Following completion of the Phase II soil gas survey, CDM will prepare a Technical Memorandum that will be a brief summary of the results of the soil gas survey. The soil gas survey results may have impacts on subsequent work planned for Phase II; these impacts will be discussed in the memorandum. This memorandum will not function as a stand alone document and will be incorporated into the Phase II Remedial Investigation Report.

6.0 PROJECT STAFFING

CDM has selected members of the project team to best match the skills of the individuals to the needs of the project. The personnel assigned to the project and their areas of responsibility are: Wendy Dewar, project manager; Mark Sorensen, field manager; Troy Carlson, field oversight; and personnel from Tracer Research Inc., Tucson, Arizona.

7.0 PROJECT SCHEDULE

The schedule for conducting the soil gas survey portion of the Southeast Rockford Phase II RI is shown on Figure 7-1. The schedule illustrates the chronological coordination of tasks from the date of project plan approval.

SOUTHEAST ROCKFORD PHASE II SOIL GAS SURVEY SCHEDULE

Task No.	Task	Duration	9/27	10/4	10/11	10/18	10/25	11/1	11/8	11/15	11/22	11/29	12/6	12/13	12/20	12/27	1/3	1/10	1/17	1/24	
1	Project Planning	4.9w																			
1.1	Work Plan Preparation	1.5w																			
1.2	Agency Reviews	3.5w																			
2	Soil Gas Survey	5.4w																			
2.1	Mobilization	1w																			
2.2	Location Staking	1w																			
2.3	Soil Gas Survey	4w																			
3	Technical Memorandum	5w																			
3.1	Data Evaluation	4w																			
3.2	Draft Report	1w																			

Project: Southeast Rockford
Date: 10/7/92

Summary Task [REDACTED] Task [REDACTED]

This Schedule does not include the source Area 7 Activities conducted in May 1992

8.0 PROJECT BUDGET

The proposed budget for conducting the soil gas survey portion of the Southeast Rockford Phase II RI is shown in Table 8-1. Back-up documentation for the tasks is provided on the subsequent pages.

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APPENDIX A

WORK PLAN FOR SOURCE AREA 7 SCREENING INVESTIGATION

WORK PLAN ADDENDUM FOR ASSESSMENT OF POTENTIAL SOURCE AREA 7

Introduction

This work plan addendum presents a description of proposed work to be completed to assess the existence and extent of contaminated wastes that may have served as source areas for contaminated groundwater observed at nearby well MW106A and other wells downgradient (west-northwest). The initial work to be completed at potential source area 7 will be installation of a surveyed grid system to allow accurate placement of locations to be tested in the electromagnetic, ground-penetrating radar, and soil gas surveys. Grid lines will be run east-west and north-south by a licensed surveyor, and points will be marked on the ground with laths at 50-foot intervals. The area to be gridded is indicated on Figure 1. The work described herein will be performed as an addendum to the Phase I scope of work. These tasks will be performed using the protocols described in the final Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP) for the Southeast Rockford Groundwater Contamination Phase I Project dated February 1991.

Field observations indicate that several areas in potential source area 7 contain various types of waste materials near the ground surface. Historical aerial photos give further such evidence. Between at least 1958 and 1970, photographs show that two small valleys southeast of MW106 were likely used for disposal of various materials. These and other past and present features are shown on Figure 1. East of MW106 a gravel pit was started by 1958. Excavation at the pit reached a peak in 1970 when the side walls produced pronounced shadows and the areal extent was approximately 200 feet by 400 feet. Other sizable disturbed areas that may have been excavations are visible in the 1970 photo, and are located northeast of the former gravel pit. Smaller areas devoid of vegetation are visible on one or more photographs from between 1958 and 1970. These various areas may have been locations of disposal of contaminated wastes that led to the groundwater contamination observed at MW106 and areas downgradient (west-northwest). The source of this

contamination is most likely located in the general area shown in Figure 1 because: 1) monitoring wells upgradient of this area show very low contaminant concentrations; and 2) the contamination of MW106 is predominantly limited to the upper well, suggesting a nearby source.

Electromagnetic Survey Plan

A terrain conductivity electromagnetic (EM) survey will be performed over part of potential source area 7 as an addendum to Phase I field work. The purpose of the EM survey is to delineate high-conductivity areas which may indicate buried metal, such as drums; such areas may have been used for disposal of contaminated wastes. The EM survey will be performed over the portions of potential source area 7 not covered by the initial survey run in March 1992, as shown in Figure 2. The area south of the 4N line was surveyed for conductivity using the EM-31 meter during an initial survey conducted by the U.S. EPA in March 1992. Therefore only the remaining portion of the grid need be surveyed for conductivity during this subsequent effort. The outlines of the areas identified as being anomalous in March will be ground-surveyed for their coordinates in the grid system shown in Figure 1, and the coordinates recorded in the field log book. Additional conductivity readings may be collected in these areas during the proposed survey to verify or more accurately outline the anomalous areas noted in the initial survey.

The remainder of potential source area 7 must be surveyed for terrain conductivity. The EM survey will consist of measuring and recording terrain conductivity values along the grid lines spaced at 25 feet. Along a specific grid line, instrument readings will be recorded at 5-foot intervals using a data logger. The equipment to be used will be a Geonics EM-31 terrain conductivity meter equipped with data logger. The meter operates on a self-contained battery pack. The sensitivity range will be adjusted in the field to provide the maximum sensitivity, such that the readings are generally in the upper one-half to two-thirds of the scale. The operator will position the EM meter over the survey location and the conductivity value (in millimhos/meter) will be automatically recorded by the data logger. Field notes

will also be taken to account for the possibility of data logger or computer malfunction. Where anomalous conductivity readings are noted, additional surrounding points may be measured in order to define the outline of the anomalous area. The EM31 can be read continuously while the operator walks, allowing the ability to define anomalously conductive areas with relatively high accuracy. Station designations (based on the coordinate system of Figure 2) and conductivity readings will be recorded by the data logger and in the field log book. Following the survey of the area, the presence and locations will be noted of any visible or suspected features that may influence readings, such as overhead wires, metal poles, near-surface wastes or disturbed soils.

Ground-Penetrating Radar Survey

The ground-penetrating radar (GPR) survey will be conducted after completion of the EM survey, so that it can be performed in areas shown to be anomalously conductive by the EM survey. The GPR operation and instrumentation will be provided by U.S. EPA personnel. In general, the GPR survey will be conducted across anomalous areas at 25-foot intervals.

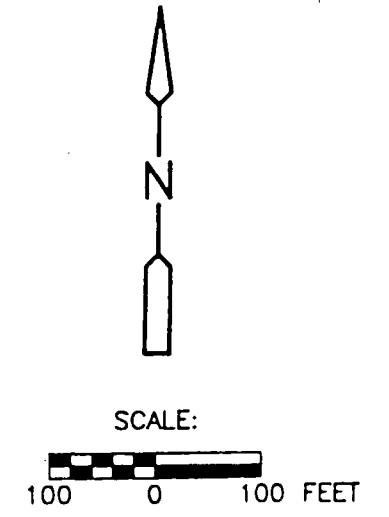
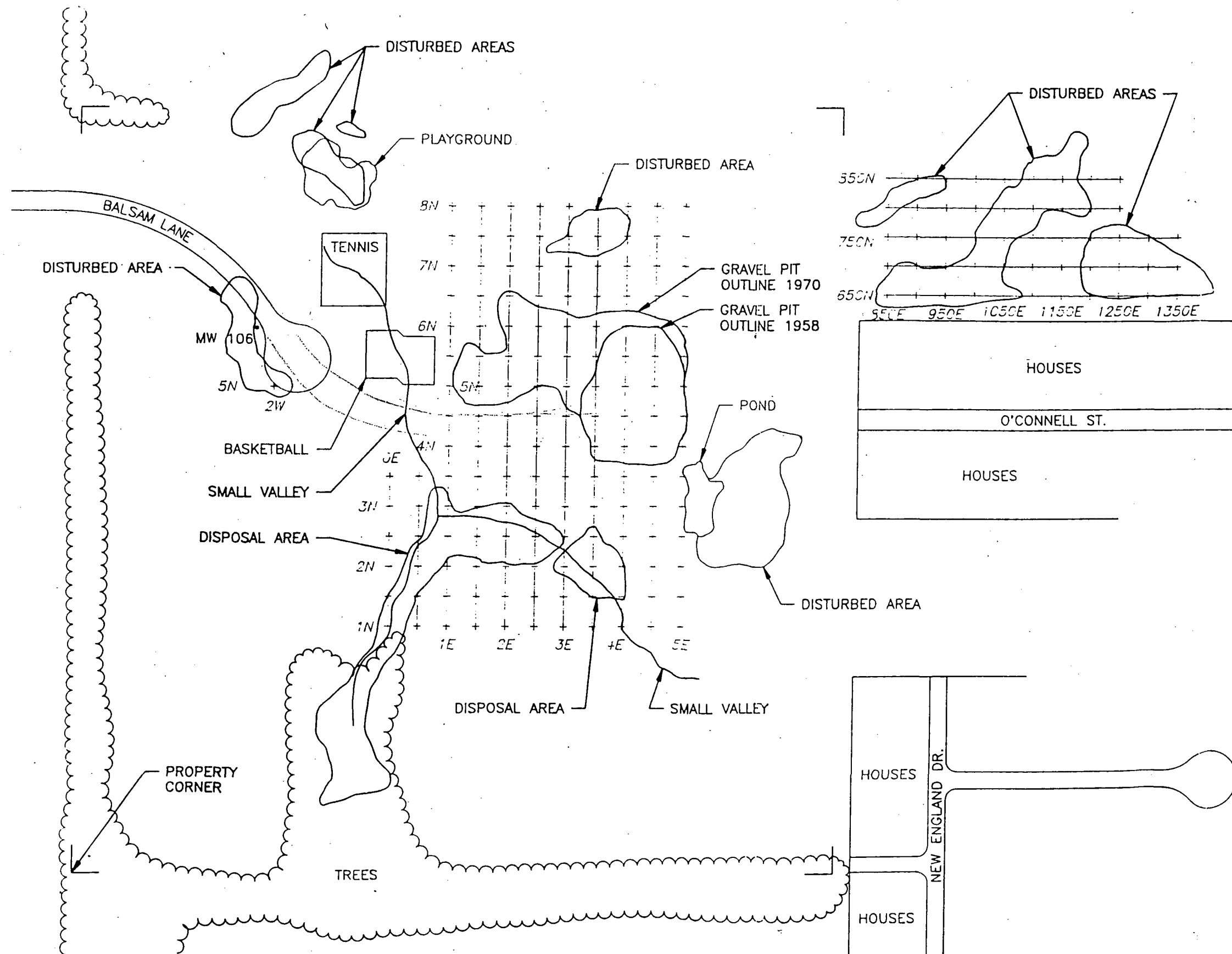
It is assumed that six anomalous areas will be defined, and that approximately eight points in each area will be measured by ground-penetrating radar, for a total of forty-eight points to be measured.

Soil Gas Survey Plan

The soil gas survey will be performed across portions of potential source area 7 by Tracer Development Corp., Tuscon, Arizona. The soil-gas procedures will be as described in the Phase I approved QAPP of February 1991. The areas to be covered are shown on Figure 3. The selection of these areas is based on the possibility of waste disposal activities as suggested by the aerial photographs. A total of 58 points in three separate areas will be tested in the soil gas survey, at grid intervals of 100 feet. Though the full chromatograms of soil-gas analyses will be retained, only the compounds of concern tetrachloroethene (PCE),

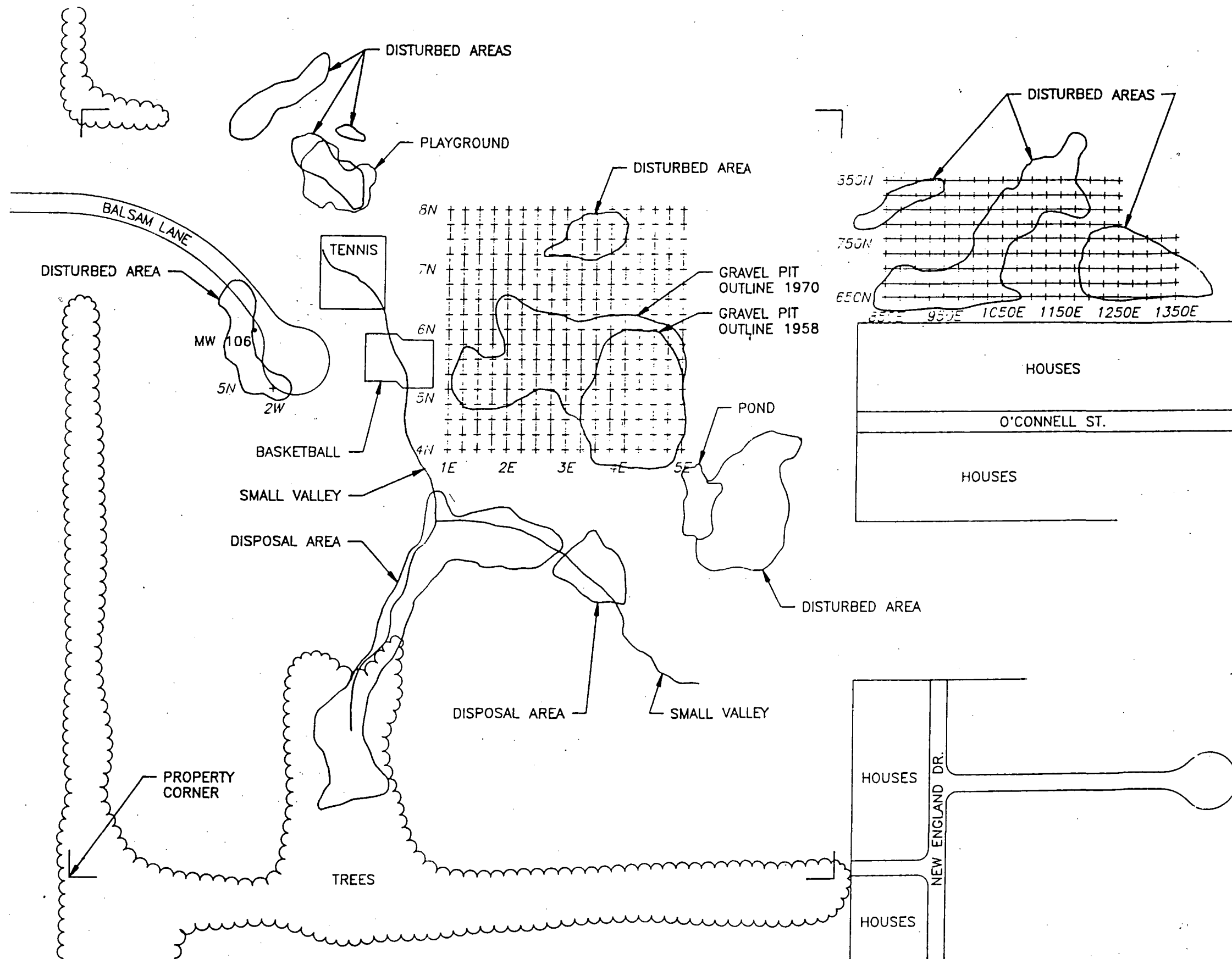
trichloroethene (TCE) and 1,1,1-trichloroethane (TCA) will be quantified in the field. It is likely that some soil-gas samples will contain anomalous concentrations of the compounds of concern. When such locations are encountered, surrounding locations at lesser intervals will be tested for soil gas constituents in order to define the outline of the area with anomalous concentrations. Such locations will be based on relative compound concentrations and the locations of the anomalous points.

The EM, GPR, and soil-gas surveys have been designed to define potential subsurface contaminant source areas. This work will be followed up in summer 1992 with Phase II field work that will focus on verification of the existence and extent of the various source areas defined in this Phase I addendum; this Phase II work will consist of drilling and soil sampling of subsurface borings, as well as installation and sampling of monitoring wells.

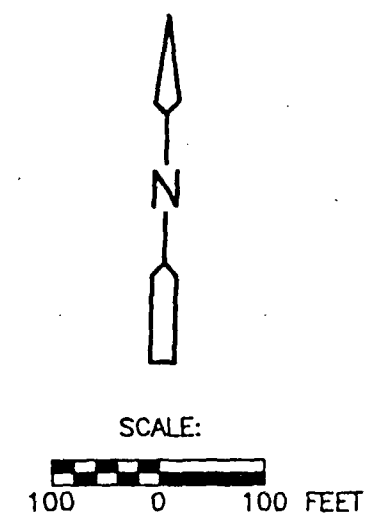
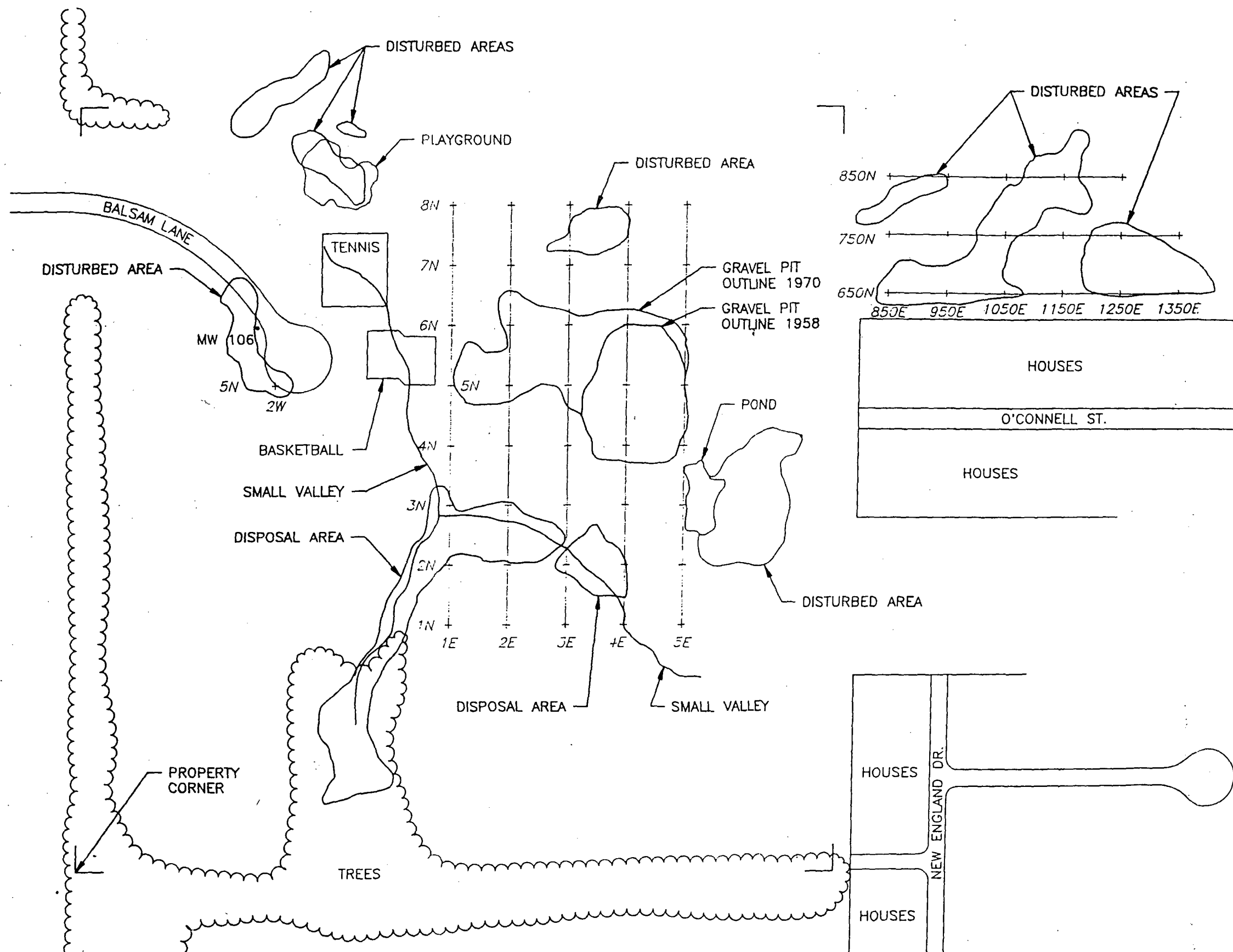


- LEGEND:**
- CURRENT FEATURES
 - PAST DISPOSAL AREAS AND OTHER FEATURES
 - SURVEY GRID POINTS

SOUTHEAST ROCKFORD
 POTENTIAL SOURCE AREA 7 — CURRENT AND PAST FEATURES, AND
 PROPOSED SURVEY GRID



SOUTHEAST ROCKFORD
 POTENTIAL SOURCE AREA 7 - CURRENT AND PAST FEATURES, AND
 ELECTROMAGNETIC SURVEY POINTS



LEGEND:

- CURRENT FEATURES
- - - PAST DISPOSAL AREAS AND OTHER FEATURES
- + + + SOIL GAS SURVEY POINTS

SOUTHEAST ROCKFORD
POTENTIAL SOURCE AREA 7 - CURRENT AND PAST FEATURES, AND
SOIL GAS SURVEY POINTS

APPENDIX B
SOIL GAS SURVEY PROCEDURES

SOIL GAS PROCEDURES

PROCEDURE

TITLE

- | | |
|------|---|
| 201 | - GC Start-up |
| 202a | - Preparation of Calibration Standards
for 3-Point Calibration |
| 203a | - 3-Point Calibration for Direct Injections Analysis |
| 205 | - Field Computer Program Operation |
| 206 | - Peak Estimation on GC Chromatograms |
| 207a | - Soil Gas Sampling Method |
| 209 | - Direct Injection Analysis of Soil Gas Samples |
| 210 | - Dilution Method for Analysis of Soil Gas Samples |
| 217 | - Decontamination of Field Supplies |
| 218 | - Gas Chromatograph Shut-Down |
| 219 | - Column Replacement and Conditioning |

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FIELD PROCEDURE NO 201

GAS CHROMATOGRAPH START-UP

PROCEDURE:

1. Check column configuration

- 1.1. If target compounds are: TCA/TCE/PCE, $\text{CH}_2\text{Cl}_2/\text{CHCl}_3/\text{CCl}_4$,
BETX

Then install: 6' OV-101 on ECD and
3' OV-101 on FID

Set column flows to: 30 mL/min N_2
(see Step 2 below)

Set column temperature to: 50 C
(see Step 8 below)

- 1.2. If target compounds are: tracers and total hydrocarbons

Then install: 6' SP1000 on ECD and
6' OV101 on FID

Set column flows to: 40 mL/min N_2 through SP1000 and
30 mL/min through OV101

Set column temperature to: 90 C

- 1.3. If target compounds are: TCA/TCE/PCE, $\text{CH}_2\text{Cl}_2/\text{CHCl}_3/\text{CCl}_4$,
BETX
Fl13, any dichloro- compounds

Then install: 6' SP1000 on ECD and
6' OV101 on FID

Set column flows to: 40 mL/min N_2 through SP1000 and
30 mL/min through OV101

Set column temperature ramp to:
90 C hold for 3 min, then
ramp to 170 C at 18 C/min

2. If you have just come to this van and GC, check all flows:

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2.1. Column carrier gas

NOTE: Flows must be set when new columns are installed or when the line pressure has been changed.

- 2.1.1. Turn on the N₂ tank valve and adjust the regulator line pressure to 60 psi.
- 2.1.2. With the ECD column disconnected from the detector insert, slip a length of surgical tubing around the end of the column.
- 2.1.3. Attach the surgical tubing to a 50 cc glass syringe and adjust the flow using the appropriate flow controller on the left front panel of the GC.
- 2.1.4. Remove the surgical tubing and repeat steps 2.1.1 through 2.1.3 to set the flow through the FID column.

2.2 FID flows

NOTE: Flows must be reset when line pressure is changed.

- 2.2.1. Use a Swagelok cap to plug the FID detector insert.
- 2.2.2. Place the FID rubber stopper in the top of the FID tower.
- 2.2.3. Turn on the air tank and adjust the line pressure to 60 psi.
- 2.2.4. Slip the surgical tubing over the rubber stopper tube and attach to the 50 cc glass syringe.
- 2.2.5. Adjust the inside screw of the air flow valve on the left front GC panel until a flow of 300 cc/min (50 cc/10 sec) is measured.
- 2.2.6. Turn off the air tank valve.
- 2.2.7. Loosen the nut to the air port on the back of the GC to bleed the line. Tighten when line pressure drops to zero on the regulator gauge and the sound of hissing stops.

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- 2.2.8. Turn on the H₂ tank valve and adjust the line pressure to 60 psi.
- 2.2.9. Adjust the inside screw of the hydrogen valve on the left front GC panel until a flow of 30 cc/min is measured.
- 2.2.10. Remove the stopper from the tower and the cap from the detector insert.
3. Slide a new ferrule over the end of the FID column and slip the column end up into the FID detector insert as far as it will go (2-3"). If the column does not slide easily, remove and straighten it before reinserting. Tighten the nut no more than 3/4 turn past finger tight.
4. Repeat Step 4 and install the ECD column in the ECD detector insert.
5. Check for leaks by placing a few drops of Leak Check above the nuts on all column fittings in the oven.
6. Turn on GC.
7. Check GC configuration of detector limits by pressing:
 - GC CONFIGURE
 - ENTER
 - 7.1. Detector limit should be set at 350 C.
8. Check that all GC parameters are set correctly by pressing:
 - BUILD/MODIFY
 - COLUMN

Proceed through the table using [ENTER] if the settings are correct or enter correct values using the keypad followed by [ENTER]:

 - 8.1. Initial column temperature: set to temperature listed in Step __ for the target compounds you will be looking for.
 - 8.2. Initial column hold time: infinite unless you have a temperature program.
 - 8.3. Injector temperature = 150 C

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- 8.4. Detector temperature = 300 C
 - 8.5. ECD initial attenuation = 1
 - 8.6. ECD range = 1
 - 8.7. ECD autozero ON
 - 8.8. FID initial attenuation = 1
 - 8.9. FID range = 12
 - 8.10. FID autozero ON
9. When the GC reaches set temperatures, ignite FID flame.
10. Note the following chromatographic parameters on the first page of the chromatograms:
- a) analyst name
 - b) date
 - c) injector, column and detector temperatures
 - d) FID and column flows
 - e) ECD and FID attenuation and range
 - f) column type, stationary phase, mesh, diameter and length
11. Turn on and initialize each integrator:
- a) date and time
 - b) file name title (CLIENT/SITE/JOB#/DETECTOR)
 - c) time functions
 - autozero(AZ) set at 0.01 min
 - peak marker(PM) set at 0.01 min
 - d) analyst
 - e) peak threshold evaluation (use PT EVAL function)
 - f) attenuation (AT=8 for FID, AT=16 for ECD)
 - g) baseline offset at 10% of peak width (OF=10)
12. Allow baselines to stabilize before calibration (about 1-2 hours).

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FIELD PROCEDURE NO 202a

PREPARATION OF CALIBRATION STANDARDS FOR 3-POINT CALIBRATION

SUMMARY OF METHOD:

A stock solution containing the chemical standard in methanol is prepared at the TRC laboratory in Tucson since the amount of glassware that can be carried in the field is limited. The stock solution is prepared by pipetting the pure chemical into methanol in a volumetric flask at room temperature. The absolute mass is determined from the product of volume and density calculated at room temperature. Hamilton microliter syringes, with a manufacturer's stated accuracy of + or - 1%, are used for pipetting. Information on density is obtained from the CRC Handbook of Physics and Chemistry.

Once the stock solution is prepared, typically in a concentration range of 20 - 10,000 mg/L, three working standards are prepared in water at the beginning of each work day by serial dilution. The working standards are prepared in 40 mL VOA septum vials by diluting the appropriate ug/L quantity of the standard solution into 40 mL of VOC-free water.

Each compound will be quantified at three concentration levels. The calibration is considered linear if the response factors are within 25% of each other. If the calibration is considered linear then a average response factor will be used to quantify sample concentrations. If not, then samples will be quantified by using the response factor that most closely matches the concentration response of the sample.

The integrity of standards during a one year period has been verified, but the standards are replaced every six months. The solute in the stock solution has a strong affinity to remain in methanol, however, they will volatilize out of solution if left exposed to ambient air for an extended period of time. It is important that the integrity of the seal remain unbroken. In other words, the cap should be removed only when standard is being removed.

SUPPLIES:

- Dedicated 10 uL syringe for methanol standard compound suite
- VOC-free water
- 40 mL VOA with Teflon-lined septum and screw cap
- Methanol standard

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PROCEDURE:

1. Analyze the VOC-free water used to make water standards once per job (or once per week if job lasts more than one week) to check its purity and check for injector insert contamination.

NOTE: This must be documented with a chromatogram.

2. Retrieve the dedicated methanol standard syringe to transfer primary stock solution to the final aqueous standard.
3. Obtain three 40 mL VOA vials with Teflon-lined septum and screw cap and fill with the VOC-free water. Label the VOAs with standard ID, concentrations, date and your initials. Make sure that no air is trapped in the VOA.
4. Remove the cap from the primary methanol standard.
5. Rinse the dedicated methanol 10 uL syringe with methanol standard twice by withdrawing approximately 5 uL of methanol standard and expelling it outside the vial.

NOTE: Do not expel the rinse into the primary methanol standard VOA as it will contaminate the standard.

6. Remove air from the dedicated 10 uL syringe needle by pulling approximately 1 uL of methanol standard into the syringe and quickly "tapping" the plunger down. Repeat this step until no air is visible when standard is pulled into the syringe barrel.
7. Inject the appropriate amount of primary methanol standard into water to yield three concentrations; 1) 5 times the detection limit, 2) 10 times #1, and 3) 10 times #2. This will yield the water standard concentrations listed in the table on the following page.

NOTE: When injecting the methanol standard into the water standard VOA, depress the microliter plunger and remove the needle from the sealed VOA. Do not rinse the needle with the newly created water standard.

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The following Table illustrates the typical concentrations of stock solutions (primary standard) prepared in MeOH to the water standard concentrations for 3-point calibration.

COMPOUND	PRIMARY STANDARD (mg/L)	WATER STANDARD (ug/L)		
	CONCENTRATION	CONCENTRATION		
		#1	#2	#3
1,1,1-TCA	50	1	10	100
TCE	100	1	10	100
PCE	50	1	10	100
CH ₂ CL ₂	2000	20	200	2000
CHCL ₃	100	1	10	100
CCL ₄	20	0.5	5	50
1,1-DCA	4000	20	200	2000
1,2-DCA	4000	20	200	2000
trans-1,2-DCE	4000	20	200	2000
cis-1,2-DCE	4000	20	200	2000
1,1-DCE	4000	20	200	2000
F-113	100	1	10	100
benzene	10,000	50	500	5000
toluene	10,000	50	500	5000
ethyl benzene	10,000	50	500	5000
xylenes	10,000	50	500	5000
EDB	200	1	10	100
F-11	100	1	10	100

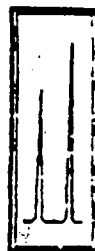
8. EXAMPLE:

Given: Compound: 1,1,1-TCA
Water standard concentration: 1 ug/L
VOC bottle volume: 40 mL + or - 2 mL

Solution: Calculate the mass of TCA required to achieve 1 ug/L concentration in 40 mL of water:

$$(0.04 \text{ liters}) \times (1 \times 10^{-6} \text{ grams TCA/liter}) = 4.0 \times 10^{-8} \text{ grams TCA}$$

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Calculate the volume of the primary standard (in MeOH)
that will contain the desired mass of TCA:

$$\frac{(2.0 \times 10^{-7} \text{ grams TCA})(1 \text{ liter primary std})}{50 \times 10^{-3} \text{ grams TCA}}$$

$$= 0.8 \times 10^{-6} \text{ liters TCA primary std}$$

So, 0.8 uL of primary standard injected into 40 mL of water gives
a final concentration of 1 ug TCA/liter of water standard.

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FIELD PROCEDURE NO 203a3-POINT CALIBRATION FOR DIRECT INJECTION ANALYSISEQUIPMENT:

- Gas Chromatograph (GC)
- Integrator
- Detector
- Computer

SUPPLIES:

- 1- or 2-cc glass syringe
- 10 uL glass syringe
- 40 mL standard VOA glass vials with septums and screw caps
- 26g 1-1/2" needles

PROCEDURE:

1. Follow Procedure 201 for GC Start-up. Instrumentation is now ready for calibration.
2. Prepare standards via Procedure 202 for target compounds.
3. Analyze one of each of the following to determine if any contamination exists in the analytical equipment or supplies.
 - 3.1. Nitrogen Blank: Blank a 1 or 2 cc syringe with nitrogen at the start of each day.

NOTE: If the representative sample of the nitrogen blank has no detectable contamination, remaining syringes need not be blanked.

If a full scale oxygen (ECD) or C₁-C₄ (FID) peak is associated with apparent contamination, it is indicative of ambient air leakage into the injection port during the injection. Repeat the injection, inserting and removing the needle as quickly as possible from the injection port.

If any of the representative syringes show contamination, all syringes must be blanked prior to use.

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If it is necessary for any syringe to be used again before cleaning, it must be blanked prior to its second use.

- 3.1.1. Obtain a clean 1- or 2-cc glass syringe and attach a needle.
- 3.1.2. Purge syringe and needle of dead volume by extracting and expelling nitrogen several times from an injection port on the GC.

NOTE: Use the injection port not being used for the injection.

- 3.1.3. Fill purged syringe with 1000 uL of nitrogen.
- 3.1.4. Quickly inject into GC port and immediately press INJECT A key on the integrator.
- 3.1.5. Analysis starts now.
- 3.1.6. Write "N₂ blank", and injection volume on chromatogram as it is being generated.

NOTE: If two detectors are being used, prepare two syringes for blanking to allow concurrent analysis. After withdrawing nitrogen from injector ports, wait for column pressures to return to normal on GC front panel gauges before injecting.

3.2. Water Blank: The VOC-free water is checked at the beginning of each job, or once a week if the job lasts longer than a week, to determine if any contamination exists in the water or injection port insert.

- 3.2.1. Obtain a clean 10 uL syringe.
- 3.2.2. Purge the syringe by drawing VOC-free water into the syringe and expelling it several times.
- 3.2.3. Draw 5 uL of VOC-free water into the syringe as measured from the end the plunger.
- 3.2.4. Pull 2 uL of ambient air into the syringe after the standard. The peak from this air injection should have the same area on each chromatogram and will demonstrate consistent technique.

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- 3.2.5. Inject the water blank into the GC.
- 3.2.6. Analysis starts now.
- 3.2.7. Write "Water blank" and injection volume on chromatogram as it is being generated.
- 3.2.8. Repeat for second detector, if used.
4. Analyze three different concentration levels for each compound at the start of each day. Then calculate the response factor (RF) for each concentration level. The RF is calculated using the following formula:

$$\frac{[\text{concentration of standard (g/L)}][\text{injection volume (L)}]}{[\text{area response injection}]}$$
$$= \text{RF (g/area)}$$

The three response factors are considered to be linear if they are within 25% of each other. In this case, the average of the response factors can be used to quantify sample concentrations. If not, then the response factor generated by peaks closest in size to that of the unknown sample will be used for quantification.

The RF allows conversion of peak areas to concentrations for the target compounds using the following calculation:

$$\frac{[\text{RF (g/area units)}][\text{peak area (area units)}]}{[\text{Volume Injected (L)}]}$$
$$= \text{Concentration (reported as ug/L)}$$

The mid-level concentration standard will be injected again after every fifth sample to check detector response and chromatographic performance of the instrument throughout the day. Acceptable response is within 25% accuracy of the established response factor.

$$\% \text{ Difference} = \frac{A \text{ area} - B \text{ area}}{A \text{ area}}$$

where A = mean peak area of 3 standard injections from first calibration; and
B = peak area of subsequent standard injection.

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If the standard injection varies by more than 25%, the standard injection is repeated. If the mean of the two standard injections represents greater than a 25% difference, then a third standard is injected and a new RF is calculated from the three standard injections.

Start a new computer worksheet if the RF changes.
Record new RF on chromatograms and logbook.

4.1. Retrieve the 10 uL water standard dedicated syringe for the compound suite of interest. If a dedicated syringe is not available, blank a 10 uL syringe and dedicate it to the water standard.

4.2. Insert needle into aqueous standard VOA and extract 5 uL.

NOTE: Make sure that no air is trapped in the barrel.

Measure the extract to the base of the metal plunger.

4.3. Pull 2 uL of ambient air into the syringe after the standard. The peak from this air injection should have the same area on each chromatogram and will demonstrate consistent technique.

4.4. Quickly inject into GC port and immediately press INJECT A key on the integrator.

NOTE: Quickly inject to avoid loss of standard around port.

5. Analysis begins now.
6. Write standard ID, concentration, and injection volume on chromatogram as it is being generated.
7. Run one standard at an attenuation such that all peak tops are visible for use in calculating a ruler number for peak estimation (Procedure 206). Run the remaining standards at the lowest possible attenuation (usually 8 for FID & 16 for ECD).
8. After duplicate analyses have been run, integration checked, and reproducibility confirmed (within 25%), input into the computer the following information (see Attachments 203-1 through 203-13 for sample standard chromatograms):
 - a) designated detector
 - b) compound retention time
 - c) standard injection volume in uL
 - d) standard concentration in ug/L
 - e) area response from three injections

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9. Press F9 on computer to compute RFS.
10. GC is now calibrated for direct injection analysis of vapor and groundwater samples.
11. Before running samples, one of each of the following should undergo analysis to determine if any contamination exists in the sampling equipment or supplies.
 - 11.1. System Blank: Systems blank are ambient air drawn through an above-ground sampling probe and complete sampling apparatus (probe adaptor, and 10 cc syringe). Analyze system blank by the same procedure as a soil gas sample (Procedure 209).
 - 11.1.1. One system blank is run at the start of each day and compared to a concurrently sampled air analyses.
 - 11.1.2. Run a system blank before reusing any sampling system component.
 - 11.2. Ambient Air Sample: Collect a 5-10 cc sample of ambient air near the system blank probe at the same time the system blank is taken. Analyze air samples by the same procedure as a soil gas sample (Procedure 209).

Run at least two additional ambient air samples during the day to monitor safety of the work environment and establish site background concentrations.
12. Input into the computer the following information for the nitrogen blank, water blank (if run), system blank and ambient air sample:
 - a) sample ID
 - b) time of analysis
 - c) sample volume
 - d) area counts of target compounds
13. Press F9 on computer to calculate concentrations. Manually calculate means for ambient air only and enter in the MEANS column (Procedure 205).
14. GC is ready for direct injection analysis of soil gas and water samples.

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Attachment 203a-1a
TYPICAL RETENTION TIMES AND ELUTION ORDER

NOTE: Each column will have packing heterogeneities that will cause the retention times to be slightly different from those listed below.

Retention times will decrease with an increase in flow and/or temperature. RTs will increase with a decrease in flow and/or temperature. A column less than 6' will have faster retention times.

1. Detector: ECD
Column: 6' OV101 (10%) on Chromosorb W (80/100 mesh)
Column Temperature: 50 C

<u>Compound</u>	<u>RT(min)</u>
1,1-dichloroethene (1,1-DCE)	0.90 ¹
methylene chloride (CH ₂ Cl ₂)	0.93 ¹
1,1,2-trichlorotrifluoroethane (F-113)	0.96 ¹
trans-1,2-dichloroethene (trans-1,2-DCE)	1.10 ²
1,1-dichloroethane (1,1-DCA)	1.13 ²
cis-1,2-dichloroethene (cis-1,2-DCE)	1.35 ³
chloroform (CHCl ₃)	1.41 ³
1,2-dichloroethane (1,2-DCA)	1.71
1,1,1-trichloroethane (TCA)	1.74 ⁴
carbon tetrachloride (CCl ₄)	1.98
trichloroethene (TCE)	2.47
tetrachloroethene (PCE)	5.64

NOTE: Boiling point is the physical characteristic governing OV101 elution order. Lower boiling point compounds elute faster than higher boiling point compounds.

Compounds with ¹, ², and ³ superscripts coelute with each other on the OV101 column. An SP1000 must be used to separate these compounds.

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Attachment 203a-ib
TYPICAL RETENTION TIMES AND ELUTION ORDER

2. Detector: FID
Column: 6' OV101 (10%) on Chromosorb W (80/100 mesh)

Order of Elution:

benzene
toluene
ethylbenzene
(meta- and para-xylene)
ortho-xylene

3. Detector: ECD
Column: 6' SP1000 (1%) on Carbopack B (60/80 mesh)

Order of Elution:

Halon 1202 (DDM)
Halon 2402 (114B2)

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FIELD PROCEDURE NO 205

FIELD COMPUTER PROGRAM OPERATION

INTRODUCTION:

The following procedure explains how to operate the computers for logging field data, data reduction and data printing. Computer use enables us to give our clients a professional-looking printout of data at the end of each working day. Before the use of computers, field data was sent back to the TRC office to be typed into a computer then proofed against the original hand-written field data sheets. This time-consuming process has been eliminated through computerization. Now the data is sent to the office on disc and printed for inclusion into reports. The computer saves time for the chemist doing the data reduction, the geologist doing the data checking, the office creating the final report, and the clients receive a daily computer-generated report.

Much time and effort has been put into this new system. Each person in the field will be required to use this system and send the disk, field data, and condensed data back to the office for report production.

HELPFUL HINTS FOR STARTING OUT:

When using the Lotus-based program, remember that Lotus looks at text (letters) and numbers differently. The computer will get confused if you input a numerical value when it is expecting only text and vice versa. For example the name 1,2-DCA: To enter this into the computer you must first press [SHIFT] then type [^]. This symbol is called the "hat" and centers the entry in the cell. Consequently to input 1,2-DCA you first need to type in the hat, e.g., "^1,2-DCA".

Another example is when inputting dual times when making injections on two different columns to two different detectors: 1201/1203. Without preceding this value with a hat, the computer will read it as a division problem. By including the hat, the computer will read it correctly as a text value with the desired result of 1201/1203.

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When entering a number as text, first press [shift] [^] followed by the text entry. The ready indicator in the upper right hand corner of the screen will change to LABEL when the [SHIFT] [^] is pressed, and return to READY when [ENTER] is pressed.

In summary:

- Always use a hat [^] to enter compound names in the calibration section, MEANS and INJECTION TIMES in the data section of the worksheet.
- Do not precede SAMPLE IDs with any character unless the ID begins with a number - then use an apostrophe [''] only before the sample ID (e.g. "'012457-6"). The [''] identifies the number as a text but does not center it as the hat does.

In this procedure, all prompts on the screen that are referred to will be shown in underlined capital letters. For example LABEL and READY shown above. Single keys that you are expected to press will be capitalized in brackets like [ENTER]. Words or symbols that you will be required to input will be capitalized in quotes.

The cursor control keys are the arrowed keys on the number keypad and allow you to move the cursor from cell to cell. The cursor key highlights its cell location on the screen. Any time an entry needs to be changed, move the cursor to the appropriate cell, type in the change and press [ENTER].

An important point to remember, if you accidentally attempt to write something into a protected cell, the computer will prompt an ERROR message. Simply hit the [ESC] key to continue entering data.

PROCEDURE:

1.0 BOOTING THE PROGRAM:

- 1.1. Insert the Tracer Field Operation Program disk into Drive A.

NOTE: This is the front disk drive on the NEC and the bottom disk drive on the Sharp computers.

Some of the computers have the Field Operation Program entered hence turning on the machine will boot and load the Field Program.

- 1.2. Turn on the computer.

NOTE: The drives will "buzz" as the program loads.

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- 1.3. When the program is loaded, the work MENU will appear in the upper right hand corner of the screen, and 2 4 6 8 10 12 14 will appear in the upper right hand corner. Move the cursor key to select the number of compounds you will be testing (see Attachment 205-1).

NOTE: Be sure to include the total number of compounds from both detectors if two detectors are being used.

If the number of compounds is an odd number such as 5, move the cursor to the next highest number, in this case 6.

- 1.4. Press [ENTER].
- 1.5. Wait for READY to appear in the upper right hand corner of the screen before proceeding.
- 1.6. Insert a formatted disk in drive B. To format a blank disk follow Steps 1.6.1-1.6.7.

1.6.1. Insert a blank disk into drive B.

1.6.2. Type "/" "S".

NOTE: This code takes it to the system.

1.6.3. Press [ENTER].

1.6.4. Type "FORMAT B:"

NOTE: Formatting a disk will erase all data on the disk. If you are unsure about the contents of a disk, type "B:" [ENTER] and "DIR" [ENTER] to look at the directory. Return to drive A by typing "A:" [ENTER].

1.6.5. Press [ENTER]. The screen will list a message indicating the formatting procedure.

1.6.6. The screen will ask if you want another disk formatted. If so, insert disk and follow the above Steps and continue for as many disks as you want prepared.

1.6.7. When finished formatting, type "EXIT" and [ENTER] to return to the Field Program.

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NOTE: This will be your data disk.

- 1.7. Use the cursor control key to the right of JOB-.
- 1.8. Type in the "CLIENT'S NAME/SITE NAME/SITE LOCATION/JOB NUMBER" (see Attachment 205-2).

NOTE: If you do not have a job number for your project, call Toni Mercado at the Tucson office and get one. The job number must be added to all field information pertaining to that particular job, including the Field Logbook.

Don't forget the hat before the entry.
Press [CAPS LOCK] for capital letters in all entries.

- 1.9. The entry will appear in the upper left hand part of the screen until [ENTER] is pressed.
- 1.10. Move your cursor to DATE.
- 1.11. Type today's date, for example, "05-15-90" and press [ENTER]. Don't forget the hat.
- 1.12. Move cursor to CHEMIST-, type in field crew leader's name and press [ENTER].
- 1.13. Move cursor the GEOLOGIST-, type in the field technician's name, and press [ENTER].

2.0 ENTERING CALIBRATION DATA:

- 2.1. Determine how many components be used with detector A.
- 2.2. For the first component for Detector A, move the cursor to the cell with a 1 to the right of DETECTOR A (Your choice is 0 or 1) and press [ENTER].
- 2.3. If component 1 is to be used on detector A, move the cursor to the 0 in the Detector B cell immediately below and press [ENTER].
- 2.4. Continue the above Steps for as many components being used for detector A.
- 2.5. For components using detector B, input a 0 for the detector A cell and a 1 for the detector B cell.

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NOTE: There must be a 1 in one detector cell and a 0 in the other.

- 2.6. Move the cursor to the cell with a zero to the right of RETENTION TIMES for component 1.
- 2.7. Type in the retention time of compound 1 and press [ENTER].
- 2.8. Move the cursor down one cell and type in the volume of standard injected for component 1 to the right of SAMPLE INJECTION (UL) and press [ENTER].
- 2.9. Move the cursor to the blank cell to the right of STANDARD CONCENTRATION (UG/L), type in the standard concentration for component 1 and press [ENTER].
- 2.10. Move the cursor to the blank cell to the right of AREA RESPONSE FROM INJECTION 1 for compound 1.
 - 2.10.1. Type in the first area response from the three selected calibration responses and press [ENTER].
 - 2.10.2. Repeat for the second and third calibration responses.
- 2.11. Move the cursor to the cell right of COMPONENT.
- 2.12. Type in the component name and press [ENTER].

NOTE: Remember to type the hat first to enter and center a text value.

If the component name is longer than 9 letters or consists of two words, type in the first nine letters of the component and move the cursor one cell down to finish the name.

- 2.13. Repeat the above procedure for all the compounds you are testing.

NOTE: Each compound has its own column so you must move the cursor to the right to enter the remaining components.

- 2.14. When all the calibration data is entered, press [F9] to calculate response factors.

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- 2.15. Once the spreadsheet is calculated, the response factor will be put in their appropriate cells and the READY signal will appear in the upper right hand corner of the screen.

NOTE: Never input a value manually in the RESPONSE FACTOR cell.

3.0. ENTERING FIELD DATA:

- 3.1. Move the cursor down until SAMPLE appears to the left of the screen.
3.2. Move the cursor to the blank cell below sample.
3.3. Type in the name of the sample name (i.e., "N2 BLANK", "SG-01-5", "01-34-56", etc.) and press [ENTER].
3.4. If two detectors are being used, type in the time injected for detector A followed by a slash (/) and then the time injected for detector B. (i.e., "1200/1203")

- 3.5. Move the cursor one more cell to the right and type in the injection volume for detector A under INJ A, and press [ENTER].

NOTE: All injection volumes are in uL.

- 3.6. If two detectors are being used, type in the injection volume for detector B under INJ B, and press [ENTER].
3.7. Move the cursor to the blank cell under AREA for component 1.
3.8. Type in the area counts for component 1 from the chromatogram, press [ENTER].

NOTE: If area is estimated mark the change on the chromatogram and enter the estimated value. If the area count is the minimum area for component 1, precede the value with a negative sign (i.e., for <1000 enter -1000).

For calculation purposes all "less than" numbers are negative.

- 3.9. Move the cursor three cells to the right, type in the area for component 2, press [ENTER].

- 3.10. Repeat Step 3.9. for all components, entering their area.
- 3.11. When all components are entered, press [F9] to calculate concentrations on the spreadsheet.
- 3.12. Move the cursor back to enter more data by pressing [HOME] followed by [END] followed by moving the down arrow one cell below.

NOTE: These commands are on the number keypad.

- 3.13. Enter the second line of data as described in Steps 3.9. through 3.12.

NOTE: To avoid confusion, leave a blank line between samples (see Attachment 224-3). To leave a blank line, you must enter a space in the sample column. Failure to enter a space will cause other functions such as saving and printing to not work correctly.

ERR will appear under CONC (concentration). This is normal and should not be cause for alarm.

4.0 ENTERING MEANS:

NOTE: The program will not calculate the average or mean needed for two duplicate injections at each sampling location for the condensed data.

It is very important to enter each of the components MEAN along the same row. If the average for component 1 of sampling point SG-01-6' is in row 45, the average for component 2 of sampling point SG-01-6' must also be in row 45 (the row number is indicated to the left of the screen.)

- 4.1. To enter average concentrations, move the cursor to the blank cell under MEAN for component 1.
- 4.2. Move the cursor down so that it is in the same row and the last entry of the first sampling point (see Attachment 224-4).
- 4.3. Make a calculation of the average for the two concentration data points needed and type in the average as a text value, press [ENTER].

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NOTE: You will always have to type in the hat before entering the means!

If the value is below the detection limit, type a < symbol after the hat followed by the detection limit.

- 4.4. Continue to enter the averages for each remaining component.

5.0. SAVING DATA:

- 5.1. Save the data in two forms: spreadsheet files and printer files.

You must save three different files for each day's data: two types of printer files and that day's spreadsheet file.

- 5.2. The two types of printer files are complete data and the other is condensed data.

NOTE: The complete data shows all the calibration data, blanks, air samples and soil gas samples.

The condensed data is only that data that was entered under the MEAN column.

- 5.3. To save a file, simultaneously press [ALT] and [S].

NOTE: A menu will appear at the left hand corner of the screen. (See Attachment 224-5).

- 5.4. To save data as a printer file, move the cursor so the the PRINTER is highlighted then press [ENTER].

- 5.5. The next menu will show CONDENSED and COMPLETE in the upper left hand corner of the screen. To save condensed data, move the cursor so that CONDENSED is highlighted, and press [ENTER].

- 5.6. The next menu will show FIRST SAVE and REPLACE SAVE in the upper left hand corner of the screen. If this is the first time you have saved that day's data with the file name you are about to enter, move the cursor so that FIRST SAVE is highlighted and press [ENTER].

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- 5.7. If you have already saved the data under the file name you are about to use, then REPLACE SAVE must be entered.
- 5.8. The next menu that appears will ask you for a file name. The following convention will be the only one used for saving printer files and spreadsheets.
- 5.9. Save the condensed data under the date followed by an "N" (for condensed) followed by a period "." followed by your van number (i.e., "V4").
- 5.10. Save complete data under the date followed by an "M" (for complete) followed by a period "." followed by your van number "V4".

For example, if the condensed data is being saved on January 10, 1990 in van 3, the file name will be "011090N.V3". Complete data will be saved under the filename "011090M.V3".

- 5.11. To save spreadsheet files, simultaneously press [ALT] AND [S].
- 5.12. Move the cursor so the SPREADSHEET is highlighted and press [ENTER].
- 5.13. The computer will prompt you for a file name. Save the spreadsheet under the date followed by the van number (i.e., "011090MV3" for January 10, 1990 in van 3) without a period or an extension.
- 5.14. If you have saved the spreadsheet previously, highlight the REPLACE command after entering the file name to be saved.

NOTE: IT IS VERY IMPORTANT THAT YOU SAVE ALL THREE OF THE FILES IN THIS ORDER. FAILURE TO DO SO WILL RESULT IN THE POSSIBILITY OF HAVING TO REINPUT ALL OF THE DATA.

6.0. SIDEWAYS PRINTING:

- 6.1. To print a file sideways, it must first be saved as a printer file.
 - 6.1.1. Connect the printer cable to the printer port of your computer and printer.
 - 6.1.2. Turn on the printer.

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- 6.2. Press "/" (slash) to obtain a list of commands at the top of the screen.
- 6.3. The work WORKSHEET should be highlighted. Move the cursor so the SYSTEM is highlighted and press [ENTER].
- 6.4. Wait for the A> (prompt) to appear on the left of the screen.
- 6.5. Type "SIDEWAYS" and press [ENTER].

NOTE: You are now in the sideways mode.

- 6.6. Move the cursor control arrows (up and down only) until the cursor highlights to the right of CHARACTER FONT:. Press the space bar until SMALL appears in the cell.
- 6.7. Move the cursor down one cell.
- 6.8. Press the space bar until you see the word DOUBLE.
- 6.9. Move the cursor down two cells to the right of LINE SPACING (dots).
- 6.10. Type "3" and press [ENTER].
- 6.11. Move the cursor to the DIRECTORY line.
- 6.12. Type "B:" and press [ENTER].
- 6.13. Move the cursor down until it is to the right of ENTER NAME OF PRINT FILE:.
- 6.14. Type the file name (i.e., "011090N.V3") and press [ENTER] (see Attachment 224-6).

NOTE: Printing begins now.

- 6.15. Print both condensed and complete data if necessary.
- 6.16. After data is printed, press [F10] to return to A>.
- 6.17. Type "EXIT" to return to the Tracer Field Program.

7. RELOADING A SPREADSHEET: You will need to reload a spreadsheet for editing if errors are found when the data is checked.

- 7.1. Insert the Tracer Field Program disk in Drive A.

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- 7.2. Insert the data disk in Drive B.
- 7.3. Turn on the computer.
- 7.4. Wait for MENU to appear in the upper right hand corner of the screen.
- 7.5. Press the [ESC] key to remove the menu.
- 7.6. Type the following keys in order: "/" "F" "D"
- 7.7. When asked for the directory, type "B:" and press [ENTER].
- 7.8. Type the following keys in order: "/" "F" "R"
- 7.9. Highlight the particular spreadsheet that needs editing via its file name and press [ENTER].

NOTE: The spreadsheet will appear with the starting menu on the upper right and left hand corners of the screen.

- 7.10. Press [ESC] to remove the menu.
- 7.11. Move the cursor to the cells that require changes.
- 7.12. Recalculate the spreadsheet data as necessary by hitting [F9].
- 7.13. After changes have been made, REPLACE SAVE the printer files.
- 7.14. Replace the existing spreadsheet file when you save it again.

A1: [W12] 'TRACER RESEARCH CORPORATION

MENT

2 4 6 8 10 12 14

2 or less compounds

	A	B		A	B	C	D	E	F
1	TRACER RESEARCH CORP	1		TRACER RESEARCH CORPORATION					
2	JOB-	2		JOB-					
3	DATE-	3		DATE-					
4	CHEMIST-	4		CHEMIST-					
5	GEOLOGIST-	5		GEOLOGIST-					
6		6							
7	DETECTOR A (0 or 1)	7		DETECTOR A (0 or 1)					1
8	DETECTOR B (0 or 1)	8		DETECTOR B (0 or 1)					0
9	RETENTION TIMES	9		RETENTION TIMES				COMP 1	0
10	SAMPLE INJECTION (uL)	10		SAMPLE INJECTION (uL)					0
11	-----	11		-----					
12	STANDARD CONCENTRATION	12		STANDARD CONCENTRATION (ug/L)					
13	-----	13		-----					
14	AREA RESPONSE 1:	14		AREA RESPONSE 1:					
15	FROM INJECTION 2:	15		FROM INJECTION 2:					
16	.	16		.					
17	-----	17		-----					
18	RESPONSE FACTOR:	18		RESPONSE FACTOR:					
19	-----	19		-----					
20	COMPONENT	20		COMPONENT					
11-Jan-89 02:51 PM									

CMD

CALC

FIG. 1

205-1a

	A	B		A	B	C	D	E	F
1	TRACER RESEARCH CORP	1	TRACER RESEARCH CORPORATION						
2	JOB-	2	JOB-						
3	DATE-	3	DATE-						
4	CHEMIST-	4	CHEMIST-						
5	GEOLOGIST-	5	GEOLOGIST-						
6		6							
7	DETECTOR A (0 or 1)	7	DETECTOR A (0 or 1)						1
8	DETECTOR B (0 or 1)	8	DETECTOR B (0 or 1)						0
9	RETENTION TIMES	9	RETENTION TIMES					COMP 1	0
10	SAMPLE INJECTION (uL)	10	SAMPLE INJECTION (uL)						0
11	-----	11	-----						
12	STANDARD CONCENTRATION	12	STANDARD CONCENTRATION (ug/L)-----						
13	-----	13	-----						
14	AREA RESPONSE 1:	14	AREA RESPONSE 1:-----						
15	FROM INJECTION 2:	15	FROM INJECTION 2:-----						
16	.	16	.						
17	-----	17	-----						
18	RESPONSE FACTOR:	18	RESPONSE FACTOR: -----						
19	-----	19	-----						
20	COMPONENT	20	COMPONENT -----						
11-Jan-89 02:51 PM			CALC						

205-2

FIG. 2

A	B	A	B	C	D	E	F
10	SAMPLE INJECTION (uL)	10	SAMPLE INJECTION (uL)				0
11	-----11	11	-----11				
12	STANDARD CONCENTRATION	12	STANDARD CONCENTRATION (ug/L)				
13	-----13	13	-----13				
14	AREA RESPONSE 1:	14	AREA RESPONSE 1:				
15	FROM INJECTION 2:	15	FROM INJECTION 2:				
16	3:	16	3:				
17	-----17	17	-----17				
18	RESPONSE FACTOR:	18	RESPONSE FACTOR:				
19	-----19	19	-----19				
20	COMPONENT	20	COMPONENT				
21	NAME	21	NAME				
22	-----22	22	-----22				
23	SAMPLE TIME	23	SAMPLE TIME INJ A INJ B		AREA	CONC.	
24	-----24	24	-----24				
25	sg-01-6' 1200	25	sg-01-6' 1200 1000		-1000	-0.001	
26	sg-01-6' 1204	26	sg-01-6' 1204 1000		-1000	-0.001	
27	sg-01-6' 1208	27	sg-01-6' 1208 1000		-1000	-0.001	
28		28				ERR	
29	sg-02-6' 1209	29	sg-02-6' 1209 1000		-1000	-0.001	
11-Jan-89 02:57 PM					CALC		

FIG. 3

205-1c

A	B	C	D	E	F	G	H
10	SAMPLE INJECTION (u10	TION (uL)					
11	STANDARD CONCENTRAT12	CENTRATION (ug/L)					
12	AREA RESPONSE 1: 14	E 1:-----					
13	FROM INJECTION 2: 15	ON 2:-----					
14	3: 16	3:-----					
15	RESPONSE FACTOR: 18	TOR: -----					
16	COMPONENT 20						
17	NAME 21						
18	SAMPLE TIME 23	TIME INJ A INJ B	AREA	CONC.	MEAN	AREA	
19	sg-01-6' 1200 25	1200 1000	-1000	-0.001			
20	sg-01-6' 1204 26	1204 1000	-1000	-0.001			
21	sg-01-6' 1208 27	1208 1000	-1000	-0.001	<0.001		
22				ERR			
23	sg-02-6' 1209 29	1209 1000	-1000	-0.001			
24	11-Jan-89 02:56 PM						

FIG. 4

CALC

205-1d

A28: U [W12]
 PRINTER SPREADSHEET
 Save as a printer file (for sideways print)

A	B	A	B	C	D	E	F
10	SAMPLE INJECTION (uL)	10	SAMPLE INJECTION (uL)				0
11	-----11	11	-----11				
12	STANDARD CONCENTRATION	12	STANDARD CONCENTRATION (ug/L)				
13	-----13	13	-----13				
14	AREA RESPONSE 1:	14	AREA RESPONSE 1:				
15	FROM INJECTION 2:	15	FROM INJECTION 2:				
16	3:	16	3:				
17	-----17	17	-----17				
18	RESPONSE FACTOR:	18	RESPONSE FACTOR:				
19	-----19	19	-----19				
20	COMPONENT	20	COMPONENT				
21	NAME	21	NAME				
22	-----22	22	-----22				
23	SAMPLE TIME	23	SAMPLE TIME INJ A INJ B		AREA	CONC.	
24	-----24	24	-----24				
25	sg-01-6' 1200	25	sg-01-6' 1200 1000		-1000	-0.001	
26	sg-01-6' 1204	26	sg-01-6' 1204 1000		-1000	-0.001	
27	sg-01-6' 1208	27	sg-01-6' 1208 1000		-1000	-0.001	
28		28				ERR	
29	sg-02-6' 1209	29	sg-02-6' 1209 1000		-1000	-0.001	
11-Jan-89 03:01 PM			CMD		CALC		

FIG. 5

205-12

S I D E W A Y S version 3.11

S/N-4838232-01
IBM Proprinter

Printer port: LPT1:

Vertical form size (inches): 11.00
Horizontal form size (inches): 8.00

Character font: Small
Density: Double
Character spacing (dots): 1
Line spacing (dots): 1

5 x 12 dot matrix

12.00 characters per inch
9.23 lines per inch

Left margin (inches): 0.00
Top margin (inches): 0.00
Bottom margin (inches): 0.00

73 lines per page

Starting page: 1
Glue lines: 0

Directory: B:\

Enter name of print file: 011089M.V3

F1 for HELP

F10 to exit

FIGURE 6

205-1F

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FIELD PROCEDURE NO 206

PEAK ESTIMATION ON GC CHROMATOGRAMS

PROCEDURE:

1. Make one of the calibration standard runs at an attenuation such that the tops of all peaks of interest are visible on the chromatogram.
2. Using a metric ruler, measure the height of each peak from baseline to top and calculate a "ruler number" for each compound using the following formula.

$$\frac{[\text{area of standard peak}][\text{sample attenuation}]}{[\text{height of standard peak (cm)}][\text{standard attenuation}]}$$

= ruler number

NOTE: A ruler number must be calculated for each compound.

3. To check integrator values, measure the peak height and multiply it by the ruler number to get an accurate integration.

e.g. standard area : 760,000 area units
standard peak height @ AT=128 : 6.7 cm
sample attenuation: 16

$$\text{ruler number} = (760,000)(16)\text{area units}/(6.7)(128)\text{cm}$$
$$= 14,179 \text{ area units/cm}$$

NOTE: If a sample peak elutes on the leading or tailing shoulder of another peak or temperature ramp, measure the peak height from the midpoint of the sloping baseline to the peak top.

If the sample attenuation changes, a new ruler number must be calculated for each compound.

4. Detection limit estimations are based on experience with minimum peak areas identifiable at different integrator attenuation settings:

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Integrator attenuation Minimum peak area

4	250
8	500
16	1000
32	2000

NOTE: These minimum peak areas should be used as a starting point to determine detection limits for your GC. Actual minimum peak sizes may vary between different columns and detectors.

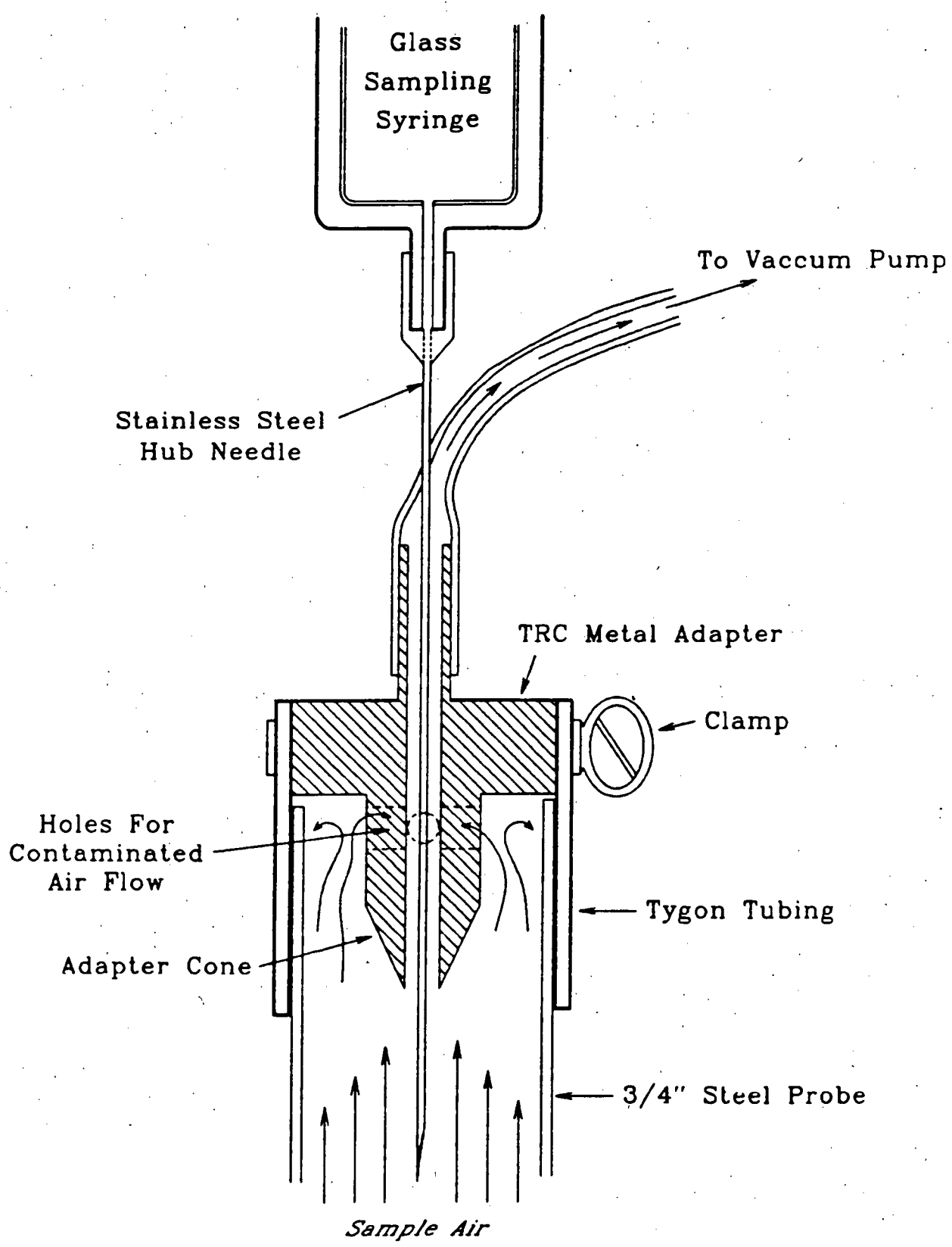
SOIL GAS SAMPLING PROCEDURES

I. Probe Placement

- A) A clean probe (3/4 inch galvanized steel pipe) is removed from the "clean" storage tube on top of the van.
- B) The soil gas probe is placed in the jaws of a hydraulic pusher/puller mechanism.
- C) A sampling drive point is inserted into the bottom of the probe.
- D) The hydraulic pushing mechanism is used to push the probe into the ground.
- E) If the pusher mechanism will not push the probe into the ground to a sufficient depth for sampling, a 30 pound hydraulic hammer is used to pound the probe into the ground.

II. Sample Extraction

- A) An adaptor (Figure 1) is attached to the top of the soil gas probe.
- B) A vacuum pump is hooked onto the adaptor via polyethylene tubing.
- C) The vacuum pump is turned on and used to evacuate soil gas.
- D) Probe vacuums are evacuated before a sample is collected. Since the flow rate is dependent on resistances to flow, the evacuation time is adjusted to assume that the proper volume is extracted.
- E) Gauges on the vacuum pump are checked for inches of mercury, which measures the resistance to flow.
 - 1) Gauge must read at least 2 inches of mercury less than maximum vacuum to be extracting sufficient soil gas to collect a valid sample.



SCHEMATIC CROSS SECTION OF THE NEW TRC PROBE ADAPTER

Soil Gas Sampling Procedures

III. Sample Collection

- A) With vacuum pump running, a hypodermic syringe needle attached to a 10 mL glass syringe is inserted through the silicone rubber, which acts as a seal, and down into the metal tubing of adaptor (Figure 1). The adaptor (TRACERs special design) is designed to eliminate the possibility of exposing the sample stream to any part of the adaptor and associated tubing.
- B) Gas samples only contact metal surfaces and never contact potentially sorbing materials (i.e., tubing, hose, pump diaphragm).
- C) The syringe is purged with soil gas. Then, without removing the syringe needle from the adaptor, a 2 to 10 mL soil gas sample is collected.
- D) The syringe and needle are removed from the adaptor and the end of the needle is plugged.
- E) If necessary, a second 10 mL sample is collected using the same procedure.

IV. Deactivation of Sampling Apparatus

- A) The vacuum pump is turned off and unhooked from the adaptor.
- B) The adaptor is removed and stored.
- C) Using the hydraulic puller mechanism, the probe is removed from the ground.
- D) The probe is stored in the "dirty" probe tube on top of the van.
- E) The probe hole is backfilled and capped, if required.

V. Log Book and U. S. EPA Field Sheet Notations For Sampling (Figures 2A-2D)

- A) Time (military notation)
- B) Sample number (use client's numbering system)
- C) Location (approximate description - i.e., street names)
- D) Sampling depth
- E) Evacuation time before sampling
- F) Inches of mercury on vacuum pump gauge
- G) Probe and adaptor numbers
- H) Number of sampling points used
- I) Observations (i.e., ground conditions, concrete, asphalt, soil appearance, surface water, odors, vegetation, etc.)
- J) Backfill procedure and materials, if used.

VI. Other Recordkeeping

- A) Client-provided data sheets are filled out, if required
- B) Sample location is marked on the site map

VII. Determination of Sampling Locations

- A) Initial sample locations are determined by client (perhaps after consultation with TRACER personnel) prior to start of job.
- B) Remaining sample locations may be determined by:
 - 1) Client
 - a) Entire job sampling locations set up on grid system.
 - b) Client decides location of remaining sample locations based on results of initial study, or
 - 2) Client and TRACER Personnel
 - a) Client and TRACER personnel decide location of remaining sample locations based on results of initial sample locations.

ANALYTICAL PROCEDURES

I. Varian 3300 Gas Chromatograph or Hewlett Packard 5890 Series II

- A) Equipped with an Electron Capture Detector (ECD), a Flame Ionization Detector (FID), a Photo Ionization Detector (PID), and/or a Thermal Conductivity (TCD) Detector.
- B) The chromatographic column used by TRACER for the analysis of halocarbons is a 1/8" diameter packed column containing Alltech OV-101. This nicely separates most of the tri-chloro and tetra-chloro compounds that are typically encountered during soil gas investigations. The di-chloro compounds tend to elute ahead of the tri-chloro and tetra-chloro compounds, thus creating no interference. In the event that assurance of the identity of a compound in any particular sample is required, it will be analyzed on a SP-1000 column after the OV-101 analysis.

II. Two Spectra Physics SP4270 or two 3396 Hewlett Packard Computing Integrators.

- A) The integrators are used to plot the chromatogram and measure the size of the chromatographic peaks. The integrators compute and record the area of each peak. The peak areas are used directly to calculate contaminant concentrations.

III. Chemical Standards from ChemServices, Inc. of Westchester, Pennsylvania.

- A) TRACER uses analytical standards that are pre-analyzed, of certified purities, and lot numbered for quality control assurance. Each vial is marked with an expiration date. All analytical standards are the highest grade available. Certified purities are typically 99 percent.

Analytical Procedures

- B) The Quality Assurance procedures used by ChemService were described by the Laboratory Supervisor, Dr. Lyle Phipper.
- 1) The primary measurement equipment at ChemServices, the analytical balance, is serviced by the Mettler Balance Company on an annual basis and recalibrated with NBS traceable weights.
 - 2) All chemicals purchased for use in making the standards are checked for purity by means of gas chromatography using a thermal conductivity detector. Their chemicals are purified as needed.
 - 3) The information on the purification and analysis of the standards is made available upon request for any item they ship when the item is identified by lot number. All standards and chemicals are shipped with their lot numbers printed on them. The standards used by TRACER are made up in a two-step dilution of the pure chemical furnished by ChemServices.

IV. Analytical Supplies

- A) Sufficient 2cc and 10 cc glass Hamilton syringes so that none have to be reused without first being cleaned.
- B) Disposable lab supplies, where appropriate.
- C) Glassware to prepare aqueous standards.
- D) Miscellaneous laboratory supplies.



SOIL GAS INVESTIGATION BACKGROUND INFORMATION

Job Number: 1-41-178-S Van Number: 1
Plate Number: 4GY DWL
Site Name: Davidson Chemical Location: 14600 West Avenue N., Larchmont, South Dakota

Dates Of Investigation:
2/16-18/84

Client Name and Address: Brandenburg Environmental
602 Hansen Rd.
Whispering, SD 57467

Field Representative(s) For Client:

Joe Pandelker

Phone Number: (783) 972-1003

Person To Whom Report And Questions Should Be Directed:

Sarah Whandel

Phone Number: (783) 972-1003

Fax Number:

972-1000

CREW:

Crew Leader: S. Charles

Field Assistant: [illegible]

Report To Include (CHECK ONE):

Additional information included in report at client's

☒ QA/QC - Procedures - Data Only

☐ Full Report With Contour Maps and Interpretation

QA/QC data

Purpose Of Investigation:

Determine extent of contamination from storage tank spill

Target VOC's:

Client's signature of target voc's verification:

Sarah Whandel

Groundwater Information (if available):

Depth To Water: 12-16'

Direction of flow: NE

Sources Of Contamination:

Company used solvents in photo-etching process in manufacture of electronic circuit boards.

Storage tank cracked and leaked from approx. 1977-1982 when company shut down. Source was removed in 1982.

Geologic Setting (e.g. soil type, subsurface geology, etc.):

Loess & glacial till (to 10'); Fractured basement below 10'.

Date:	2-16-84	Job Number	1-41-178-S
Location:	14600 West Avenue N., Leithorn, South Dakota	Client:	Davidson Clinical

TIME	SAMPLE NUMBER	DEPTH FT	PROBE #	PROBE PUSH/ POUND (in Hg)	VACUUM M	E V A C TIME (s)	S A M P L E VOL (cc)	P O I N T S USED	NOTES/ADD'L DATA REQUESTED This includes, but is not limited to, sampling location and general area, ground conditions, asphalt, concrete, soil appearance, odors, backfill procedures and materials, etc.
0845	System Blank	N/A	16	N/A	3	305	8	N/A	
0900	SG-01	6'	27	1.5'	3			1	70E storage tank. NE of sampling point. Lines of leaking dead, frozen tanks and dripping in leading bay to SD' E.
0915	SG-02	6'	301	1.5'	5	305	7 1/2		slightly appears as degraded to less consistency. Soft and like in appearance & feels no need to drill, probe pushed through easily; patched when done.
0941	SG-40	5 1/2'	45	1.5'					More two-puddle asphalt; client has indicated that patch won't be necessary.

DAILY SUMMARY

DATE: 2-16-89 CLIENT: Brandenburg Environmental JOB NUMBER: 1-41-178-S

WEATHER: 12 degrees F., snow squalls, cold & breezy

FIELD HOURS	
Time on Site: 0730	Lunch Hours 1
Time off Site: 1730	Downtime Hours ¹ 0
	Standby Hours ² 0
Client's signature verifying time on and off site: Sarah Whend	
Billable Hours (office use only):	
NOTE: REPORT TIME TO NEAREST 0.1 HOURS	

DECONTAMINATION	
Probe Decontamination	System Contamination
Total Hours: 4	Total Hours: 1/2
Signature of verification by GC Operator: S. Whend	Signature of verification by Field Assistant: M. Pomeroy

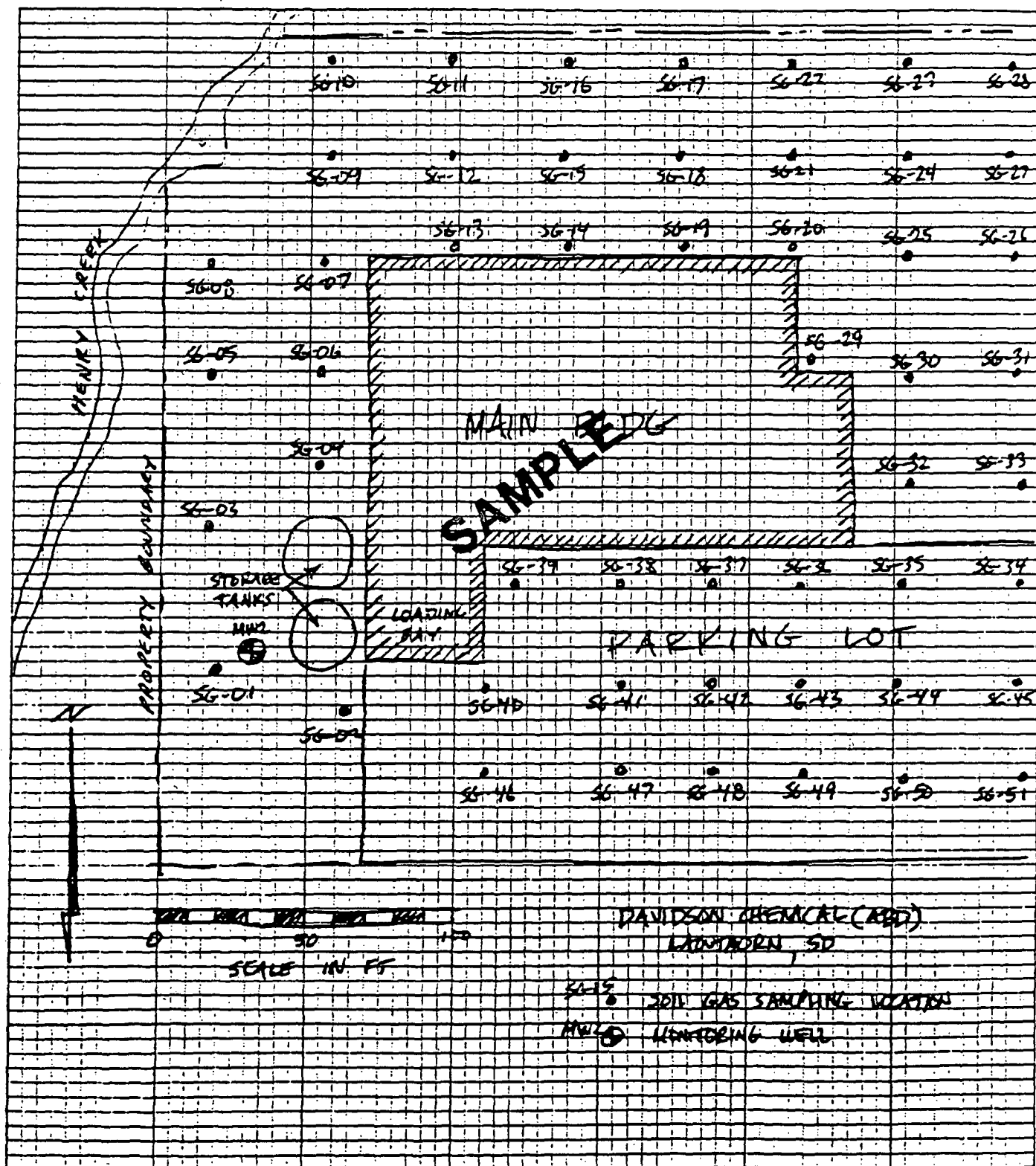
SAMPLING AND ANALYSIS		
Calibration	Sampling	Analysis
Time Start: 0730	Vacuum used (Check one): <input type="checkbox"/> Diaphragm <input checked="" type="checkbox"/> Transducer	Total System Blanks: 1
Time End: 0830	Max Vacuum: 23 (in Hg)	Total Ambient Air Samples: 3
Total Hours: 1	Probes Used: 18	Total Analytical Blanks: 1
	Points Used: 20	Total Reagent Blanks: 1
	Soil Gas Samples Collected: 18	Water Samples Collected: 0

Downtime includes time spent repairing sampling & analytical equipment; note times and explanation on following field data pages

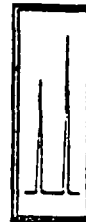
Standby includes time available for sampling but waiting for client; note times and explanation on following field data pages

Tracer Research Corporation

SITE MAP



SITE MAPS TO INCLUDE: SITE NAME, SCALE, NORTH ARROW, SOIL GAS LOCATIONS & NUMBERS, CULTURAL AND NATURAL FEATURES TO IDENTIFY



SITE MAPS

DRAW SITE MAPS TO SCALE and include:

- Job number
- Client
- Site name and location
- Scale, both bar and inch equivalent
- North arrow (approximate)
- Soil gas locations and numbers
- Cultural and natural features to identify the site

IF MAPS ARE SUPPLIED BY CLIENT, CHECK FOR ACCURACY AND CLARITY AND **LOSE**

MAP (S) HAVE BEEN CHECKED FOR COMPLETENESS AND ACCURACY:

M. Javorani

Signature of Field Assistant

SAMPLE

DETECTOR A (0 or 1)
DETECTOR B (0 or 1)
RETENTION TIMES
SAMPLE INJECTION (uL)

	1		1		1
	0		0		0
COMP 1	0.78	COMP 2	1.1	COMP 3	1.7
	5		5		5

STANDARD CONCENTRATION (ug/L):	3	10	5	10
AREA RESPONSE 1:	95310	2000456	1148076	
FROM INJECTION 2:	103683	1956743	1114123	
3:	107198	2150578	1126578	
RESPONSE FACTOR:	5	4.90E-16	1.23E-17	4.43E-17
COMPONENT NAME	F113	TCA	TCE	

SAMPLE	TIME(A/B)	INJ A	INJ B	AREA	CONC.	MEAN	AREA	CONC.	MEAN	AREA	CONC.	MEAN
6	H2O BLANK	755	5	-1000	-0.09797	<0.1	-1000	-0.00245	<0.002	-1000	-0.00885	<.009
7	N2 BLANK	800	1000	-1000	-0.00048	<0.0005	-1000	-0.00001	<.00001	-1000	-0.00004	<.00004
	AIR SAMPLE 8	825	1000	2000	0.000979	0.001	4702	0.000057	.00006	12569	0.000556	0.0006
	SYSTEM BLANK 9	845	1000	2000	0.000979	0.001	5560	0.000068	.00007	10724	0.000474	0.0005
	SG01-5'	941	1000	15342	0.007515	0.008	5400	0.000066	.00007	351625	0.015560	0.02
	SG01-5'	947	1000	17986	0.008811		5874	0.000072		410552	0.018168	
10	WS-18	955	1	3424	1.677384	2	-1000	-0.01227	<0.01	40528	1.793498	2
	WS-18	1003	1	3650	1.788099		-1000	-0.01227		44715	1.978786	

1. Site and staff information.
2. Name of compound.
3. Concentration of analyte in calibration standard.
4. Peak areas obtained from standard injections during calibration.
5. Response factor (RF) for compound obtained from three calibration runs. The RFs are used for calculation of actual concentrations and are included on each data sheet.
6. Water blank verifies purity of standard water and cleanliness of injection system.
7. Nitrogen blank verifies decontamination of syringes and analytical equip.
8. Air sample gives ambient concentrations for comparison with system blank.

207A

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FIELD PROCEDURE 209

DIRECT INJECTION ANALYSES OF SOIL GAS SAMPLES

SUMMARY OF METHOD:

Chromatographic retention time identifies halocarbon and hydrocarbon compounds detected in soil gas. If necessary, verification of compound identity can be obtained by chromatographic analysis via columns of differing polarity and selectivity.

Quantification of compounds is achieved by comparison of the detector response of the sample with the response measured for calibration standards (external standardization). System blanks are run at the beginning of the day to check for contamination in the soil gas equipment. Instrument calibration checks are run periodically throughout the day. Air samples are also routinely analyzed to check for background levels in the atmosphere. At least three air samples should be collected each day.

Proprietary modifications to the gas chromatograph allow direct injections of soil gas and aqueous samples/standards for analysis. Results of both soil gas and water injection analysis should be available to the client within 30 minutes of sample collection.

EQUIPMENT:

- Gas Chromatograph (GC)
- Integrator
- Detector
- Computer

SUPPLIES:

- 10 uL, 1- and 2-cc glass syringes
- 40 mL standard VOA glass vials with septum screw caps
- 26g 1-1/2" needles
- Reagent grade water
- Calibration Standard
- 22 mm Teflon/Silicon septa

PROCEDURE:

1. Follow Procedure 201 for GC Start-up.

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2. Follow Procedure 202 for Preparation of Calibration Standards.
3. Follow Procedure 203 for Calibration for Direct Injection Analysis.
4. Instrumentation is now ready for sample analyses. Run samples as they are collected.
 - 4.1. All unknown samples will be analyzed at least twice.
 - 4.2. Duplicate samples will be run until reproducibility is within 25% computed as follows:

$$\% \text{ Difference} = \frac{|A - B|}{(A + B)/2}$$

Where: A is first measurement result; and
B is second measurement result.

If the difference is greater than 25%, run a subsequent sample until two measurements are made that have a difference of 25% or less which will be used in the final calculation for that sample.

- 4.3. Inject as much sample as possible without exceeding linear range of the detector (10 times the area of the standard peak).
- 4.4. Whenever possible, keep the attenuation for unknown samples constant throughout the day to facilitate verification of integration and peak estimation (Procedure 206).
- 4.5. Document all changes.
- 4.6. Use a water plug as a gas seal in 10 uL syringes when making injections.
- 4.7. Establish a seal between syringes when subsampling by using an injection port septum.
- 4.8. If linear range is exceeded for any compound, reduce the injection size until the response becomes linear.
- 4.9. If response remains outside of linear range with a 0.5 uL injection, dilute the sample via Procedure 210.

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NOTE: Dilutions should be avoided if possible. Small injections with microliter syringes produce more reliably accurate results.

- 4.10. Document all sample analyses.
- 4.11. If a new RF is calculated, start a new computer work-sheet.
- 4.12. Label all analyses in ug/L. Avoid PPM and PPB notations.
5. Obtain a clean 1- or 2-cc glass syringe and attach needle. This is the subsampling syringe.
6. Place an injection port septum midway up the needle to create a seal for subsampling.
7. Remove the capped needle from the 10 cc sample syringe and quickly insert the subsampling syringe needle, sealing the injection port septum against the sample syringe needle mount.

NOTE: Slide the subsampling syringe needle so that it fits snugly on the injection port septum creating a seal between the two syringes.

8. Purge the subsampling syringe and needle several times with sample to lessen the effect of needle deadspace dilution.
9. Extract 1000 uL by pushing sample from the sample syringe into the subsampling syringe.

NOTE: This is called a subsample.

Actual sample volume will be determined by the response of the target compounds. The volume ranges from 0.5 uL for high response to 1000 uL for low response. Often, the client is aware of potential sources and can warn you when high concentrations are expected.

10. Return the capped needle to the original 10 cc sample syringe to trap sample inside syringe.
11. Quickly inject into GC port and immediately press INJECT key on the integrator.

NOTE: Quickly inject to avoid loss of sample around port.

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12. Analysis begins now.
13. Write sample ID and sample volume on chromatogram as it is being generated. 13. After duplicate analyses have been run, integration checked, and reproducibility confirmed (within 25%), input into the computer the following information for each injection:
 - a) sample ID
 - b) time of analysis
 - c) volume of injection
 - d) area counts of target compounds
14. Press F9 on computer to calculate concentrations. Manually calculate the mean concentration for each compound and enter in the MEAN column.
15. After all samples have been analyzed save condensed data, complete data, and spreadsheet to disk (Procedure 205).
16. Remove used needles from used syringes. Stopper the ends of the used needles to the Teflon/Silicon septa to keep needles together and ready for decontamination. Place used syringes in a separate container for decontamination.

PREPARED BY _____ APPROVED BY _____
PROCEDURE NO 210 REVISION NO 0
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FIELD PROCEDURE NO 210

DILUTION METHOD FOR ANALYSIS OF SOIL GAS SAMPLES

SUMMARY OF METHOD:

When VOCs being analyzed are present at very high concentrations such that they are outside the linear range of the detector, the following allows dilution of the sample to get usable analytical results. Linear range extends from detection limit to 10 times the standard peak area (approximately).

The optimal ratio for dilution is 1:100.

PROCEDURE:

1. Obtain a contaminant-free 10-cc glass syringe.
2. Purge syringe and needle of dead volume by extracting and expelling nitrogen several times from the nitrogen port on the GC.

NOTE: Use the injection port not being used for injection for nitrogen source.

3. Fill purged 10-cc syringe with nitrogen and plug needle.
4. Obtain a clean 1-cc glass syringe with needle.
5. Place an injection port septum midway up the needle of the 1-cc syringe to seal when subsampling.
6. Remove the capped needle on the 10-cc sampling syringe and quickly insert the subsampling syringe needle, sealing the needle against the 10-cc syringe needle mount with the injection port septum.
7. Purge the 1-cc syringe with sample to minimize the effect of needle deadspace dilution.
8. Push 100 uL of sample from the 10-cc sampling syringe into the 1-cc subsampling syringe.

NOTE: This is called a subsample.

9. Return the plugged needle to the original 10-cc sample syringe.

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- NOTE:** Hold the syringes firmly together against the injection port septum creating a seal between the two syringes.

- NOTE: The 1-cc syringe is now contaminated and cannot be used for injection into the GC. Set aside for decontamination.

- $$\text{net original sample injection size} = (\text{dilution ratio})(\text{injection volume})$$

SG-1: 100 uL @ $\frac{1}{100}$ dilution = 1 uL on chromatogram

- a) sample ID
- b) time of injection
- c) net injection size
e.g., 1 uL for Step 13 example
- d) area counts of compounds of interest

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17. If the 1:100 dilution is above linear range at 1 μ L injection, repeat steps 1 through 14 by diluting 1 μ L of original sample (using a blanked 10 μ L syringe with water plug) into 10 cc of nitrogen to yield a 1:10,000 dilution.

PREPARED BY _____ APPROVED BY _____
PROCEDURE NO 217 REVISION NO 0
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FIELD PROCEDURE NO 217

DECONTAMINATION OF FIELD SUPPLIES

1. SAMPLING EQUIPMENT DECONTAMINATION:

- 1.1. STEEL SAMPLING PROBES: Steel sampling probes are used only once during the day and then washed with high pressure soap and hot water spray or steam-cleaned to eliminate the possibility of cross contamination.
- 1.2. PROBE ADAPTORS: Probe adaptors are designed such that samples are collected upstream from the adaptor. Since the sample is collected before it reaches the adaptor, a single adaptor can be reused. Adaptors are washed when dirty and tygon replaced when visibly worn.
- 1.3. SILICON TUBING: Silicon tubing is replaced as needed to ensure proper sealing around the syringe needle. Used tubing is discarded.
- 1.4. TYGON TUBING: Tygon tubing is replaced as needed to ensure cleanliness and a good fit. Used tubing is discarded.

2. ANALYTICAL SUPPLIES DECONTAMINATION: No analytical equipment shall be reused until decontaminated in the following manner.

- 2.1. GLASS SYRINGES AND VOAs: All glass sampling and sub-sampling syringes (1cc, 2cc, and 10cc) and VOAs are decontaminated after each work day by the following:
 - 2.1.1. Wash in hot water with Alconox or equivalent detergent.
 - 2.1.2. Rinse thoroughly to remove all soap residue.
 - 2.1.3. Rinse thoroughly with IPA or methanol.
 - 2.1.4. Bake at 90°C overnight a minimum of 1 hour or until dry.
 - 2.1.5. Reassemble syringes as soon as they are cool checking to make sure the plungers spin in the barrels.

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NOTE: Do not leave syringes unassembled as accumulating dust will ruin them.

2.1.6. Inspect syringes daily for cracks. Syringes with cracks and/or frozen plungers should be discarded. Do not use cracked syringes.

2.2. uL SYRINGES: All uL syringes are decontaminated at the end of each work day by the following:

2.2.1. Rinse uL syringes thoroughly with IPA.

2.2.2. Purge rinsed uL syringes with nitrogen by inserting into an injection port until IPA is evaporated (no more than 15 seconds).

2.2.3. If necessary, use Syringe Kleen to remove metal deposits in barrel.

2.2.4. Rinse completely with IPA.

2.2.5. Inspect syringes for cracks. Syringes with cracks and/or frozen plungers cannot be reconditioned and should be returned to Ken Tolman in the Lab. Do not use cracked syringes.

NOTE: Never bake uL syringes in the oven as it will crack the barrel.

3. INJECTION PORT SEPTA: Injection port septa through which samples are injected in the chromatograph are discarded and replaced on a daily basis to prevent possible gas leaks from the chromatographic column.

PREPARED BY _____ APPROVED BY _____
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FIELD PROCEDURE NO 218

GAS CHROMATOGRAPH SHUT-DOWN

1. After the last analysis of the day, new septa are placed in the injection ports to allow time for them to condition before the next day's analyses.
2. Column temperature is increased to 180 C to bake out residual contamination.

NOTE: Check your column specifications as to the correct temperature settings for bake out.

3. Follow decontamination procedures described in Procedure 217.
4. Turn off dryers.
5. Turn off hydrogen and air to FID (if used) using tank valves.

NOTE: Nitrogen should only be turned off (at the tank) if the GC is not to be used for more than three days.

Never turn off the nitrogen while the ECD is above ambient temperature as this will accelerate detector foil deterioration.

6. Turn off power switch to GC, integrators and printer.
7. Turn generator off.
8. If GC is to be plugged in overnight, establish line power and turn the GC back on.

PREPARED BY R. S. Cherba APPROVED BY _____
PROCEDURE NO 219 REVISION NO 0
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FIELD PROCEDURE 219

COLUMN REPLACEMENT AND CONDITIONING

SUPPLIES:

- 60/80 Carboxpack B/1% SP1000 - SUPELCO, Bellefonte, PA
Cat. No.: 1-1815, 15g
Cat. No.: 1-1915, Mono-Pak, 4g
Maximum Temperature: 225°C
- 80/100 Chromosorb W/10% OV101 - SUPELCO, Bellefonte, PA

PROCEDURE:

1. COLUMN REPLACEMENT:

- 1.1. Turn off the oven.

NOTE: If, in your experience, it takes longer than 5 minutes to change a column, you must first turn off the detectors and allow them to reach ambient temperature (often >1 hour). The ECD must never be exposed to air at elevated temperatures without nitrogen flowing through it. This will cause accelerated detector foil deterioration.

To save time, become well practiced at changing columns in less than 5 minutes.

- 1.2. Loosen the nuts attaching the column to the detector insert and dryer.
- 1.3. Remove the column.
- 1.4. Add a new vespel ferrule to the coiled end of the new column and attach it to the union on the 1/16" dryer line. Check for leaks by placing a few drops of Leak Check around the top of the nut.

NOTE: Columns are supplied with a straight 4" section at one end to allow easy insertion into the detector insert. Be careful not to bend it.

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Always use vespel ferrules for all fittings. Vespel ferrules are easily replaced and do not damage columns and other lines. Metal ferrules, once tightened, are not removeable and will ruin a column if used. Metal ferrules are only used to seal lines from the tank regulators to the rear of the GC.

DO NOT attach the detector end of the new column to the detector insert. Doing so will cause impurities driven off of the conditioning column to contaminate the detector.

Always check all fittings for leaks whenever getting into and out of the oven.

2. COLUMN CONDITIONING:

2.1. Set the column nitrogen flow (Procedure 201).

2.2. The ECD must always have nitrogen flowing through it during the conditioning process.

2.2.1. If you are conditioning a column for the ECD and have a conditioned column on the FID, remove the FID column from the detector insert and attach it to the ECD. Do not attach the ECD column to the FID.

NOTE: The FID will not have nitrogen flowing through it during the conditioning process.

2.2.2. If you are conditioning new columns for both detectors:

2.2.2.1. Connect the two columns in series on the FID dryer line. If one of the columns is an SP1000, place it upstream from the OV101 (i.e., attach the SP1000 to the line from the FID dryer). The OV101 is less sensitive to contamination and is purged faster than the SP1000.

2.2.2.2. Connect the ECD dryer line directly to the detector insert on the ECD.

2.2.2.3. Check for leaks.

2.2.2.4. Set the column flow (Procedure 201).

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2.3. Program the GC with the following:

2.3.1. For an SP1000 or SP1000 and OV101 set:

- COLUMN INITIAL TEMPERATURE: 50 C
- COLUMN INITIAL HOLD TIME: 30 min
- COLUMN FINAL TEMPERATURE: 210 C
- COLUMN TEMPERATURE RATE: 2 C/min
- COLUMN FINAL HOLD TIME: 15 hrs

2.3.2. For an OV101 columns only set:

- COLUMN TEMPERATURE: 210 C
- COLUMN HOLD TIME: INF

3. COLUMN CONNECTION:

- 3.1. Disconnect the column or dryer line from the ECD.
- 3.2. Match and connect columns to dryer lines as needed.
- 3.3. Check column flows.
- 3.4. After column has been conditioned, add a new vespel ferrule and insert column into detector and push as far as it will go (about 2-1/2").

NOTE: Column must be connected correctly or chromatography will be inaccurate.

Column should slide easily into detector insert. If not, remove and straighten until it slides easily. DO NOT forcibly insert a column into the detector insert.

- 3.5. Leak check all fittings.
- 3.6. Set up GC (Procedure 201). Stabilized baseline should be no more than 50 mV. Typical baselines are as follows:

- FID/OV101: 10-25 mV
- ECD/OV101: 10-40 mV
- ECD/SP1000: 10-40 mV

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4. COLUMN BACK PRESSURE AND FLOW RATE:

4.1. Carbopack columns exhibit greater back pressure than those made with Chromosorb W as indicated on the gauges on the left front panel of the GC. The following are typical column back pressures:

<u>STATIONARY PHASE</u>	<u>SUPPORT</u>	<u>N₂ FLOW</u>	<u>ACCEPTABLE BACK PRESSURE @ 70°C</u>
OV 101	Chromosorb W	30 mL/min	20-25 for 6' column
SP 1000	Carbopak B	40 mL/min	25-30 for 6' column

- Notice that as the column temperature increases, column back pressure also increases for the same flow rate.

PACKED COLUMN INJECTORS

FIGURE 4-1
CROSS-SECTIONAL VIEWS OF 1040 HEATED ON-COLUMN INJECTOR
WITH 1/8" AND 1/4" OD AND MEGABORE COLUMNS

